INSTRUCTION MANUAL
OSCILLOSCOPE
MODEL 5630

Kikusui
INTERNATIONAL CORP.

MODEL 5630
OSCILLOSCOPE

TABLE OF CONTENTS

		PAGE
1.	GENERAL	1
2.	SPECIFICATIONS	2
3.	NOTES IN OPERATION, AND PANEL DESCRIPTION	8
3.1	Notes in Operation	8
3.2	Explanation of Front Panel	9
3.3	Explanation of Rear Panel	17
4.	OPERATION METHOD	21
4.1	Basic Operation	21
4.2	Dual-channel Operation	23
4.3	ADD Operation	24
4.4	Triggering	24
4.5	Single-sweep Operation	30
4.6	Sweep Magnification	31
4.7	Waveform Magnification with Delayed Sweep	32
4.8	Delayed ALT Sweep	34
4.9	B ENDS A Mode	35
5.	METHODS OF MEASUREMENTS	36
5.1	Connection Method of Input Signal	36
5.2	Voltage Measurement	39
5.3	Current Measurement (Voltage drop method)	39
5.4	Time Measurement	40
5.5	Frequency Measurement	40
5.6	Measurement of Phase Difference	42
5.7	Characteristics of Pulse Waveform	42
6.	CIRCUIT DESCRIPTION	45
6.1	General	45
6.2	CH1 and CH2 Preamplifier	48
6.3	Vertical Switching Circuit	51
6.4	Delay line	55
6.5	Vertical Output Amplifier	56
6.6	A and B Trigger Generators	58
6.7	A and B Sweep Generators	62
6.8	Horizontal Switching Circuit	67
6.9	Horizontal Output Amplifier	68
6.10	Z-axis Amplifier	70
6.11	CRT Control Circuit	71
6.12	HV Regulator (High Voltage Generator)	72
6.13	Power Supply Circuit	72
6.14	Calibrator Circuit	73

PAGE

7. CALIBRATION 75

7.1 General 75
7.2 Removing the Case 75
7.3 Check and Adjustment of DC Supply Voltages 76
7.4 Adjustment of CRT Circuits 77
7.5 Adjustment of Vertical Axis 79
7.6 Adjustment of Trigger Circuits 85
7.7 Adjustment of Time Base 87
7.8 Adjustment of Horizontal Axis (X-axis) 90
7.9 Adjustment of Caliblation Voltage 91
7.10 Calibration of Probe 101

* Block diagram 103

* CIRCUIT SCHEMATICS 105

* REPLACEABLE PARTS 129

* PARTS LOCATIONS 139

1. GENERAL

Kikusui Model 5630 Oscilloscope is a general-purpose dual-channel portable oscilloscope with a 6-inch rectangular type internal-graticule 80 mm × 100 mm (3.15 in. × 3.94 in.) cathode-ray tube.

The vertical axis has a maximum sensitivity of 1 mV/DIV (when in the "5 × MAG" mode) and a frequency response of up to 35 MHz (-3 dB). A X-Y mode of operation can be attained in a one-touch control operation.

The trigger circuit is capable of selecting six different types of signal sources. It incorporates with an alternate trigger function and a level lock function which facilitate and simplify the trigger operation.

The sweep time range is as wide as 0.5 sec - 0.1 μsec. The maximum sweep speed is 10 nsec/DIV (when in the "10 × MAG" mode). A sweep delay and alternate sweep function are included enabling parallel observation of the magnified waveform and non-magnified waveform. Also incorporated is a variable trigger hold off function which simplifies observation of sophisticated waveforms or digital signals of irregular repetitions.

2. SPECIFICATIONS

Vertical Axis

Item	Specification	Remarks
Sensitivity	5 mV/DIV - 5 V/DIV 1 mV/DIV - 1 V/DIV (with 5 × MAG)	1-2-5 sequence, 10 ranges.
Sensitivity accuracy	±3% or better ±5% or better (with 5 × MAG)	When VARIABLE knob in CAL'D position
Variable vertical sensitivity	To 1/2.5 or less of panel-indicated value	
Frequency response	DC: DC - 35 MHz DC - 10 MHz (with 5 × MAG) AC: 2 Hz - 35 MHz 2 Hz - 10 MHz (with 5 × MAG)	With reference to 50 kHz, 8 DIV. within -3 dB
Rise time	Approx. 10 nsec (Approx. 35 nsec when in "5 × MAG")	
Signal delay time	Approx. 40 nsec (with delay line of approx. 120 nsec)	Displayable section of waveform before trigger point
Square wave characteristics	Overshoot: 3% or less Ringing: 2% or less Sag: 2% or less	DC coupling, 4 DIV amplitude 200 kHz (20°C - 35°C (68°F - 95°F))
Input coupling	AC, DC, GND	
Input impedance	1 MΩ ±2%, 20 pF ±2 pF	
Maximum allowable input voltage	400 Vp-p (DC + AC peak)	Frequency 1 kHz or lower
Polarity switching	Channel 2 only	
DC balance shift	±0.5 DIV ±2.0 DIV (with 5 × MAG)	
operation modes	CH1, CH2, CHOP, ALT, ADD, X-Y (CH1 — X, CH2 — Y)	

Item	Specification	Remarks
CHOP frequency	Approx. 500 kHz	
Common mode signal rejection ratio	50:1 or better, at 50 kHz sinusoidal wave	With uniform sensitivities of CH1 and CH2
Isolation between channels	At least 1000:1 at 50 kHz At least 30:1 at 35 MHz	At 5 mV/DIV range (without CHOP mode)

CH1 Signal Output

Item	Specification	Remarks
Output voltage	Approx. 20 mV/DIV into 1 MΩ load Approx. 10 mV/DIV into 50Ω load	One division of deflection gives approx. output voltage.
Output resistance	Approx. 50Ω	
Output frequency response	DC - 35 MHz, -3 dB	At 50Ω terminated
Output DC level	Approx. 0 V	

Trigger A and B (A: Main sweep, B: Delayed sweep)

Item	Specification	Remarks
Trigger signal source	A: INT, LINE, EXT, EXT ÷ 10 INT (CH1, CH2, NORM) B: INT, EXT	When in NORM, triggering is ALT TRIG. B EXT terminal is on rear panel.
Coupling mode	A: AC, HF REJ, TV, DC B: AC only	When in TV, signal is connected to trigger circuit after synchronization signal separation.
Slope	"+" and "-"	Both A and B
A trigger sensitivity	AC: 10 Hz - 10 MHz 0.4 DIV (0.04 V) 3 Hz - 35 MHz 1.0 DIV (0.1 V) DC: DC - 10 MHz 0.4 DIV (0.04 V) DC - 35 MHz 1.0 DIV (0.1 V) HF REJ: 10 Hz - 50 kHz 1.0 DIV (0.1 V)	Figures enclosed in brackets indicate EXT input trigger voltage sensitivities.

Item	Specification	Remarks
	TV: Video signal 1.0 VID (0.1 V)	
B trigger sensitivity	10 Hz - 10 MHz 0.4 DIV (0.04 V) 3 Hz - 35 MHz 1.0 DIV (0.1 V)	AC only
AUTO operation	Satisfies the trigger sensitivity specification for signal repetition frequency of 50 Hz or over.	
NORM	When no trigger signal input is applied, trace is blanked out and is in the READY state.	Satisfies the specification of trigger sensitivity.
SINGLE	One-shot sweep with trigger signal. Can be reset to the READY state by means of RESET switch.	
LEVEL LOCK	Satisfies the values mentioned in the above items of trigger sensitivity plus 0.5 DIV (0.05 V), for a signal of duty cycle 1:5 - 5:1 and repetition frequency 50 Hz or over.	When in TV sync trigger, usable with video signal amplitude of 0.5 - 2.0 DIV.
External input impedance	A: Approx. 1 MΩ, 30 pF or less B: Approx. 1 MΩ, 35 pF or less	
Maximum allowable input voltage	100 V (DC + AC peak)	AC: 1 kHz or lower

Horizontal Axis

A sweep and B sweep

Item	Specification	Remarks
Sweep time	0.1 μsec - 0.5 sec/DIV 10 nsec - 50 msec/DIV (when in "10 × MAG")	1-2-5 sequence, 21 ranges.
TIME/DIV variable (sweep time)	Can be varied (made slower) from panel- indicated value by a factor of 2.5 or over.	For A sweep only

Item	Specification	Remarks
Sweep time accuracy	±3% or better ±5% or better (when in "10 × MAG")	
Linearity	3% or better 5% or beter (when in "10 × MAG")	
Position shift caused by sweep magnification	Within ±0.5 DIV at CRT center	
Sweep mode	A, A INTEN, ALT, B	

Sweep Delay

Item	Specification	Remarks
Delay system	Continuous delay or Triggered delay	
Sweep delay time	5 sec - 1 μsec	
Sweep delay time accuracy	Within ±3% on CRT Within ±3% of multi-dial indication (excluding 0 - 0.50)	
Delay jitter	1/10,000 or less $\frac{\text{B sweep time}}{\text{A sweep time}} \times \frac{\text{jitter width}}{\text{10 DIV}}$	Jitter width 1.0 DIV or less at A: 1 msec/DIV and B: 1 μsec/DIV

External Sweep

Item	Specification	Remarks
Mode	X-Y mode CH1 ... X axis (HOR.) CH2 ... Y axis (VERT.)	
Sensitivity	5 mV - 5 V/DIV	The same as CH1
Sensitivity accuracy	±3% or better	The same as CH1
Frequency response	AC: 2 Hz - 2 MHz DC: DC - 2 MHz	With reference to 50 kHz, -3 dB
X-Y phase difference	3° or less (DC - 50 kHz)	

Z Axis

Item	Specification	Remarks
Sensitivity	3 Vp-p (Trace becomes brighter with negative input.)	
Frequency response	DC - 5 MHz	
Input resistance	Approx. 5 kΩ	
Maximum allowable input voltage	50 Vp-p (DC + AC peak)	AC: 1 kHz or less

CRT

Item	Specification	Remarks
Type	6-inch rectangular type, internal graticule	
Fluorescent screen	P31	Green
Acceleration voltage	Approx. +8.5 kV / -1.5 kV	Approx. 10 kV
Effective CRT screen size	8 × 10 DIV	1 DIV = 1 cm (0.39 in.)
Graticule	Internal graticule,continuously variable illumination	
Unblanking	DC coupling	

Calibration Voltage

Item	Specification	Remarks
Waveform	Positive-going square wave	
Frequency	Approx. 1 kHz	
Duty ratio	Within 45:55	
Output voltage	2 V ±2% 200 mV ±2%	
Rise time	Approx. 0.1 μsec	
Output resistance	2 V: approx. 2 kΩ 200 mV: approx. 200Ω	

Power Requirements

Item	Specification	Remarks
AC line voltage ranges	A: 90 - 110 V B: 104 - 126 V C: 194 - 236 V D: 207 - 253 V	Voltage ranges are selectable with selector plug.
Frequency	50/60 Hz	
Power consumption	Approx. 55 VA	

Mechanical Specification

Item	Specification	Remarks
Dimensions of main body alone	310 W × 150 H × 400 D mm (12.20W × 5.91H × 15.57D in.)	
Maximum dimensions	370 W × 190 H × 480 D mm (14.57W × 7.48H × 18.90D in.)	With handle on top of casing
Weight	Approx. 9.7 kg (21.4 lb.)	

Ambient Conditions

- o Normal operating ranges: Temperature ..... 5°C - 35°C (41°F - 95°F)
  Humidity ..... 85% RH max.
- o Maximum operating ranges: Temperature ..... 0°C - 40°C (32°F - 104°F)
  Humidity ..... 90% RH max.

Accessories:

- o 960 BNC probes (1/10, 1/1, 1.5 m) ..... (89-03-0220) 2
- o 942A terminal adaptor ..... (W4-986-011) 1
- o Slow blow fuse, 0.5 A ..... (99-02-0115) 1
- o Slow blow fuse, 1 A ..... (99-02-0120) 1
- o Power cord ..... ( ) 1
- o Short bar ..... ( ) 1
- o Instruction manual ..... ( ) 1

3. NOTES IN OPERATION, AND PANEL DESCRIPTION

3.1 Notes in Operation

o AC line voltage:

This instrument can be operated on any one of the AC line voltages shown in the following table. The required voltage can be selected by means of the voltage selector plugs. Before operating the instrument, ensure that the AC line voltage setting of the instrument conforms with the voltage of the AC line on which the instrument is to be operated. If the instrument voltage does not conform with the line voltage, the instrument may not operate normally or may be permanently damaged.

When the instrument AC line voltage is changed, change the fuse also referring to the follwing table.

Symbol	Center voltage	Operating voltage range	Fuse
A	100 V	90 - 110 V	1 A
B	115 V	104 - 126 V	slow blow
C	215 V	194 - 236 V	0.5 A
D	230 V	207 - 253 V	slow blow

o Environments:

The normal ambient temperature range of this instrument is 5°C - 35°C (41°F - 95°F). Operation of the instrument outside of this temperature range may cause damage to the circuits.

Do not use the instrument in a place where strong magnetic or electric field exists. Such fields may disturb the measurement.

o CRT intensity:

In order to prevent permanent damage to the CRT, do not make the CRT trace excessively bright or leave the spot stationary for more than a few moments.

o Withstanding voltages of input terminals:

The withstanding voltages of the instrument input terminals and probe input terminals are as shown in the following table. Do not apply voltages higher than these limits.

CH1, CH2 inputs	400 Vp-p (DC + AC peak)
Probe input	600 Vp-p (DC + AC peak)
EXT TRIG input	100 Vp-p (DC + AC peak)
Z AXIS input	50 Vp-p (DC + AC peak)

Note: AC Frequency is 1 kHz or below.

3.2 Explanation of Front Panel (See Figure 1.)

o CRT circuits:

POWER ..... (21) Main power switch of the instrument. When this switch is turned on, lamp (22) is also turned on.

INTEN ..... (23) Controls the brightness of the spot or trace.

B INTEN ..... (24) Semi-fixed potentiometer for adjusting the intensified sweep or B sweep brightness.

FOCUS ..... (25) For focussing the trace to the sharpest image.

ILLUM ..... (27) Graticule illumination adjustment.

TRACE ROTATION ..... (26) Semi-fixed potentiometer for aligning the horizontal trace in parallel with graticule lines.

o Calibration Voltage:

CALIB 2 V ..... (29) Terminal for 2 V calibration voltage output. Output resistance is approximately 2 kΩ.

200 mV ..... (28) Terminal for 200 mV calibration voltage output. Output resistance is approximately 200 Ω.

o Vertical axis:

CH1 (X) input ..... ⑨ Vertical input terminal of CH1. When in X-Y operation, X axis (abscissa) input terminal.

CH2 (Y) input ..... ⑮ Vertical input terminal of CH2. When in X-Y operation, Y axis (ordinate) input terminal.

GND ..... ⑪ Ground terminal of instrument

AC-GND-DC ..... ⑧ ⑯ Switch for selecting connection mode between input signal and vertical amplifier.

AC: AC coupling

GND: Vertical amplifier input is grounded and input terminals are disconnected.

DC: DC coupling

VOLTS/DIV ..... ⑤ ⑬ Select the vertical axis sensitivity, from 5 mV/DIV to 5 V/DIV with 10 ranges.

VARIABLE ..... ⑥ ⑭ Fine adjustment of sensitivity, with a factor of 1/2.5 or over of panel-indicated value. When in the CAL'D position, sensitivity is calibrated to panel-indicated value. When not in the CAL'D position, the UNCAL lamp ③ or ⑲ turns on.

POSITION ..... ⑦ ⑫ Vertical position control of the trace or spot.

5 × MAG ..... ④ ⑰ Magnifies by 5 times the sensitivity of vertical amplifier. When in this mode, the "5 × MAG" lamp ② or ⑳ turns on

CH2 POLARITY ..... (18) This switch selectes the polarity of the signal applied to CH2 input terminal. The ▮ state is the normal polarity and the ▁ state is the inverted polarity.

VERT MODE ..... (1) Selects the operation mode of the vertical axis.

CH1: CH1 alone operates.

CH2: CH2 alone operates.

ALT: Dual-channel operation with CH1 and CH2 swept alternately. Suitable for observation with fast sweep speed.

CHOP: Dual-channel operation with CH1 and CH2 chopped at a frequency of approximately 500 kHz. Suitable for observation with slow sweep speed.

ADD: For measurement of algebraic sum or difference of CH1 and CH2 signals, employing the function of CH2 POLARITY switch.

X-Y: X-Y operation with CH1 for X axis and CH2 for Y axis.

INT TRIG ..... (10) Selects the internal trigger signal source. The signal selected by this switch is fed to the A trigger circuit if SOURCE switch (37) is set in the INT state or to the B trigger circuit if SOURCE switch (54) of rear panel is set in the INT state.

CH1: Input signal of CH1 is used as trigger signal.

CH2: Input signal of CH2 is used as trigger signal.

NORM: Input signal which is displayed on CRT screen is used as trigger signal. When in the ALT mode, triggering also is in an alternate mode and the signals of both CH1 and CH2 are alternately used for triggering respective channels.

- Trigger Circuit:
  (Refer to explanation of the rear panel for B trigger.)

EXT TRIG INPUT ..... (35) Input terminal for external trigger signal.

SOURCE ..... (37) Selects the trigger signal.

INT: Internal signal selected by INT TRIG switch (10) is used as trigger signal.

LINE: AC line signal is used as trigger signal.

EXT: Input signal of EXT TRIG INPUT terminal (35) is used as trigger signal.

EXT ÷ 10: Input signal of EXT TRIG INPUT terminal is attenuated to by a factor of 1/10 and used as trigger signal.

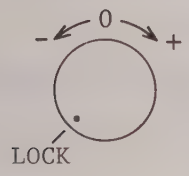
COUPLING ..... (36) Selects coupling mode between trigger source circuit and trigger circuit and also selects connection mode for the TV sync. circuit.

AC: Trigger signal is applied through an AC coupling circuit.

HF REJ: Trigger signal is applied through an AC coupling circuit, with attenuation of signal components higher than 50 kHz.

TV: TV sync. separation circuit is connected to the trigger circuit, and the sweep is triggered in synchronization with TV.V or TV.H signal at sweep speed selected by the A TIME/DIV switch (45) .
TV.V: 0.5 sec - 0.1 msec/DIV
TV.H: 50 μsec - 0.1 μsec/DIV

LEVEL ..... (33) Controls the trigger level for setting the start point of displayed waveform. As this knob is turned in "→+" direction, the trigger level moves upward on the displayed waveform; as the knob is turned "- ←", the level moves downward.



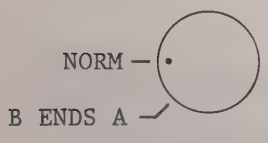
When set in the LOCK position, the trigger level is automatically maintained at an optimal value irrespective of the signal amplitude (from very small amplitude to large amplitude), requiring no manual adjustment of trigger level.

SLOPE ..... (32) Selects the triggering slope.

"+": Triggering occurs when the trigger signal crosses the trigger level in positive-going direction.

"-": Triggering occurs when the trigger signal crosses the trigger level in negative-going direction.

A HOLD OFF ..... (31) This knob is used when the signal waveform is complex and stable triggering cannot be attained with LEVEL knob (33) alone. When this knob is set in the "B ENDS A" position, the A sweep ends at the same time the B sweep ends.



With this function, degradation of brightness can be minimized when in the delayed sweep with large magnification of waveform in the horizontal direction.

TRIG'D ..... (42) When the A sweep operates, the TRIG'D lamp (42) turn on.

o Sweep Circuits

A, B TIME/DIV ..... (45)
AND DELAY TIME (46)

The large knob (45) is for A TIME/DIV and DELAY TIME, and the medium knob (46) is for B TIME/DIV.
The A TIME/DIV knob sets the A sweep rate; the DELAY TIME knob sets the delaying sweep rate.
The B TIME/DIV switch sets the delayed sweep rate.

A VARIABLE ..... (44) Continuously-variable adjustment of A sweep rate. Value indicated by A TIME/DIV switch (45) can be reduced by a factor of 2.5 or more. When set in the CAL'D position, the sweep speed is calibrated to the value indicated by the A TIME/DIV switch. When not in the CAL'D position, the UNCAL lamp (41) turns on.

10 × MAG ..... (39) The A or B sweep is expanded by 10 times and, therefore, the sweep time becomes 1/10. When in this operation, the "10 × MAG" lamp (38) turns on.

POSITION ..... (47) Horizontal position control of spot or trace.
←→

FINE ..... (48) Fine adjustment of horizontal positioning. Especially useful when in the "10 × MAG" operation.

DELAY TIME MULTI ..... (49) Multi-turn potentiometer for continuously variable adjustment of the delay time indicated by the A sweep knob (45) in order to select the section to be expanded of the A sweep.

SWEEP MODE ..... (43) Selects the desired sweep mode.

AUTO: When no adequate triggering signal is applied or when signal frequency is less than 50 Hz, sweep runs automatically.

NORM: When no adequate triggering signal is applied, sweep is in a ready state and the return trace is blanked out. Used primarily for observation of signals of 50 Hz or lower.

SINGLE: (PUSH TO RESET) Used for single sweep operation (one-shot sweep operation) in conjunction with the reset switch.

When the three buttons are in the pushed out state, the circuit is in the single sweep mode. The circuit is reset as this button is pressed. When the circuit is reset, the READY lamp (40) turns on. The lamp goes off when the single sweep operation is over.

HORIZ DISPLAY ..... (50) Selects A and B sweep mode as follows:

A: Main sweep (A sweep) mode for general waveform observation.

A INTEN: This sweep mode is used when selecting the section to be magnified of the A sweep. The B sweep section (delayed sweep) corresponding to the A sweep is displayed with high brightness.

ALT: A sweep and B sweep (delayed sweep) are displayed alternately. (The A, B TRACE SEPARATION control (34) is used to set vertical separation so that the waveforms can be clearly observed.

B: Displays the delayed sweep (B sweep) alone.

B TRIG'D: Selects between continuous delay and triggered delay.

▙ : For continuous delay. Sweep starts immediately after the sweep delay time determined by DELAY TIME switch (45) and DELAY TIME MULTI knob (49), irrespective of B trigger signal.

▁▙ : For triggered delay. Sweep starts with B trigger signal after the sweep delay time determined by DELAY TIME switch (45) and DELAY TIME MULTI knob (49). (Controls for B trigger circuit are located on the rear panel.)

A, B TRACE SEPARATION ..... (34) Semi-fixed potentiometer for separating the vertical positions of the A and B sweeps when in the ALT mode.

3.3 Explanation of Rear Panel

o B Trigger Circuit

EXT TRIG INPUT ..... (51) Input terminal for external trigger signal of B sweep.

LEVEL ..... (52) Trigger level adjustment of B sweep. When set in the LOCK position, trigger level is automatically maintained irrespective of signal amplifude (from very small signal to large signal).

SLOPE ..... (53) Selects the slope for the triggering point of sweep.

SOURCE ..... (54) Selects the trigger signal for B sweep.

INT: Signal selected by INT TRIG switch (10) is AC coupled to B trigger circuit.

EXT: Input signal applied to EXT TRIG INPUT terminal (51) is AC coupled to trigger circuit.

o Z Axis

Z AXIS INPUT .... (55) (56) Input terminals for external intensity modulation signal. Binding post terminals with 19-mm (0.75 in.) spacing.

o CRT Circuit

ASTIG ..... (62) Astigmatism control of CRT. This control, in conjunction with the FOCUS control, should be so adjusted that the spot or trace displayed on the CRT screen is made sharpest.

o CH1 SIGNAL OUTPUT ... (63) This output terminal provides CH1 signal which is fed to a frequency counter, etc.

o AC Power Input Circuit

AC power input connector ..... (59)
Input connector of the AC power of the instrument. Connect the AC power cord (supplied) to this connector.

FUSE ..... (60) Fuse in the primary circuit of the power transformer. Fuse rating is as shown in the AC line voltage table (61) on the instrument rear panel.

AC voltage selecting connector ..... (57)
For selecting the AC voltage of the instrument in conjunction with selector plug (58)

AC voltage selector plug ..... (58)
For selecting the AC voltage of the instrument in conjunction with selector connector, as indicated with A, B, C, D symbols with reference to the AC line voltage table (61) on the instrument rear panel.

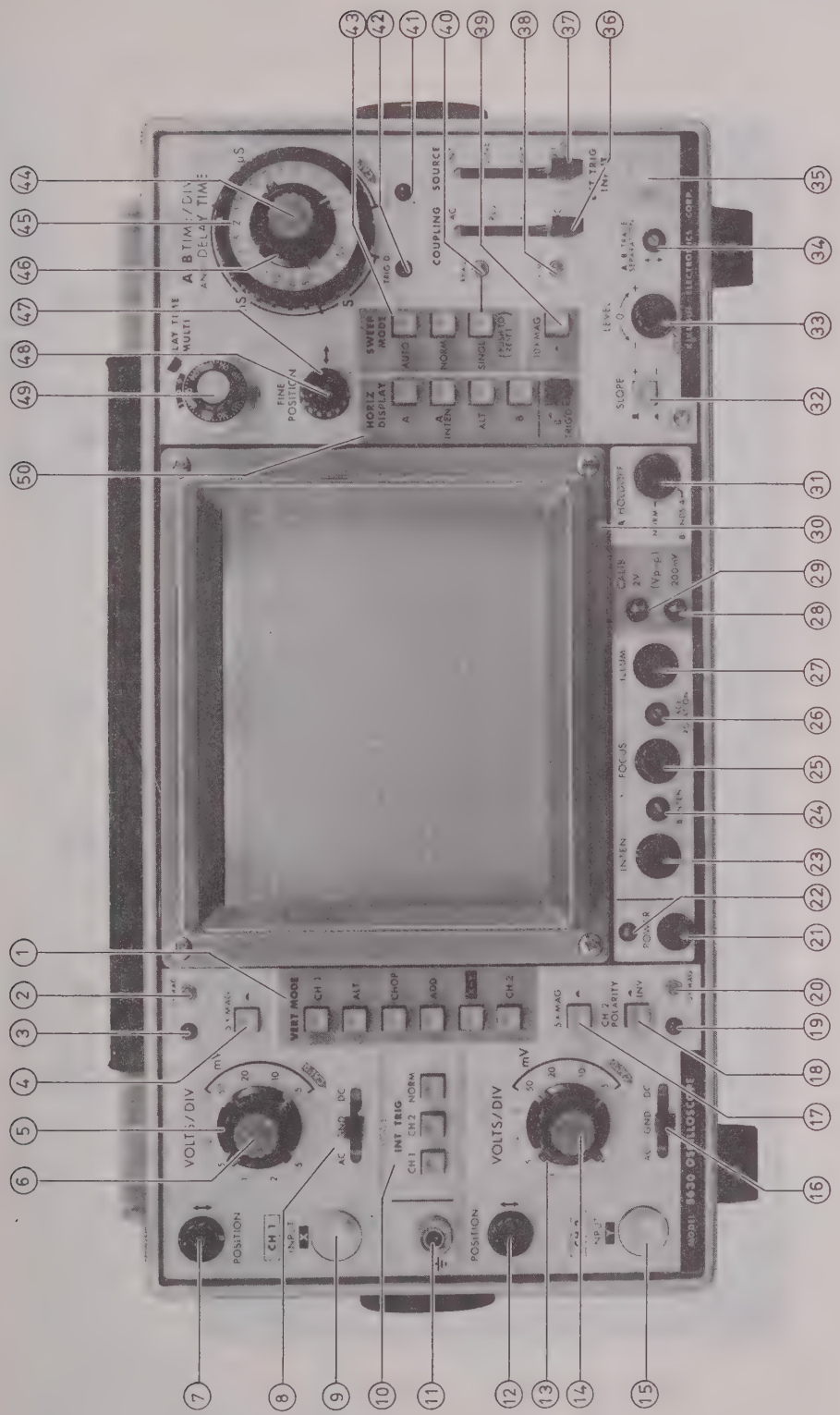


Figure 1. Front panel of the oscilloscope

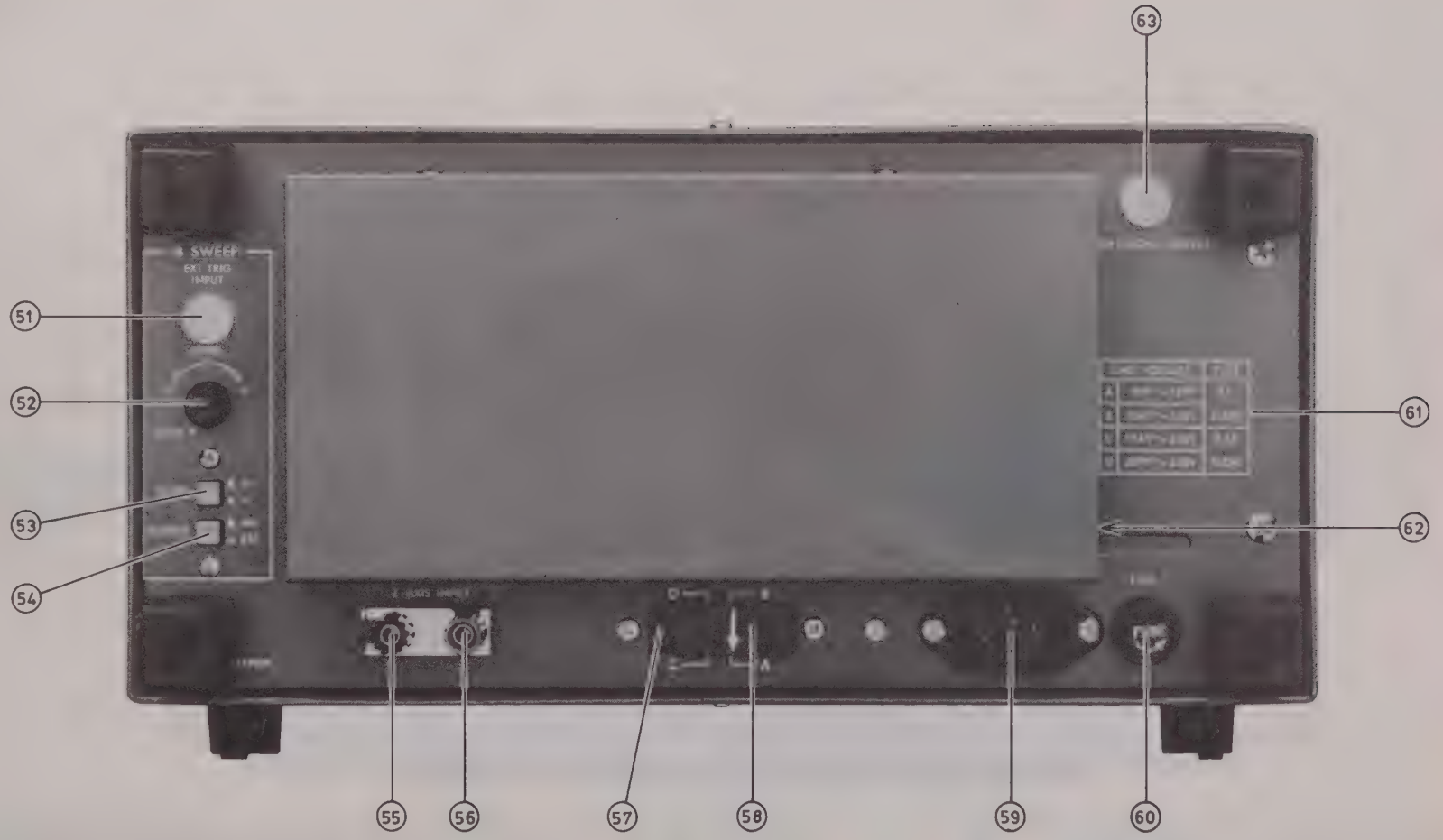


Figure 2. Rear panel of the oscilloscope

4.1 Basic Operation (Refer to Figure 1.)

Before connecting the power cord to an AC line outlet, check that the AC line voltage selector plug on the rear panel of the instrument correct set for the AC line voltage. After ensuring the voltage setting, set the switches and controls of the instrument as shown in the following table.

Item	No.	Setting
POWER	㉑	OFF position
INTEN	㉓	Clockwise (3-o'clock position)
FOCUS	㉕	Mid-position
ILLUM	㉗	Counterclockwise position
VERT MODE	①	CH1
↕ POSITION	⑦ ⑫	Mid-position
VOLTS/DIV	⑤ ⑬	50 mV
VARIABLE	⑥ ⑭	CAL'D (clockwise position)
AC-GND-DC	⑧ ⑯	GND
5 × MAG	④ ⑰	▮ OFF
CH2 POLARITY	⑱	▮ NORM
INT TRIG	⑩	NORM
SOURCE	㊲	INT
COUPLING	㊱	AC
LEVEL	㉝	LOCK (counterclockwise)
SLOPE	㉜	▮ "+"
A HOLD OFF	㉛	NORM (counterclockwise)
SWEEP MODE	㊸	AUTO
HORIZ DISPLAY	㊿	A

Item	No.	Setting
10 × MAG	(39)	▮ OFF
TIME/DIV	(45)	0.5 mS
VARIABLE	(44)	CAL'D (clockwise)
←→ POSITION	(47) (48)	Mid-position

After setting the switches and controls as above, connect the power cord to the AC line outlet and, then, proceed as follows:

1) Turn-ON the POWER switch and ensure that the power pilot LED above is also turned on. In about 20 seconds, a trace will be appeared on the CRT screen. If no trace appears in about 60 seconds, repeat the switch and control settings as shown in the above table.

2) Adjust the trace to an appropriate brightness and sharpest image with the INTEN control and FOCUS control.

3) Align the trace with the horizontal center line of graticule by adjusting the CH1 POSITION control and TRACE ROTATION control (screw driver adjust).

4) Connect the probe (supplied) to the CH1 INPUT terminal, and apply the 200 mVp-p CALIBRATOR signal to the probe tip.

5) Set the AC-GND-DC switch in the AC state. A waveform as shown in Figure 3 will be displayed on the CRT screen.

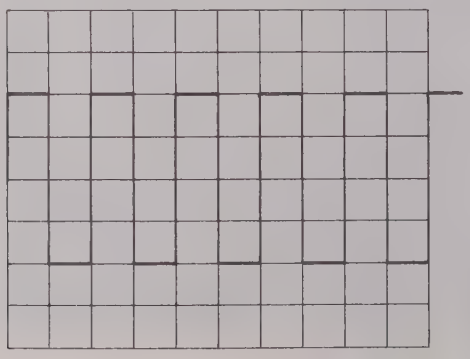


Figure 3

6) Adjust the FOCUS control so that the trace image becomes sharpest.

7) For signal observation, set the VOLTS/DIV switch and TIME/DIV switch in appropriate positions so that the signal waveform is displayed with an appropriate amplitude and an appropriate number of peaks.

8) Adjust the ↕ POSITION and ↔ POSITION control in appropriate positions so that the displayed waveform is aligned with the graticule and the voltage (Vp-p) and period (T) can be read conveniently.

The above is the basic operating procedure of the oscilloscope. Further operation methods are explained in the subsequent paragraphs.

4.2 Dual-channel Operation

Two signals can be simultaneously displayed on the screen by setting the VERT MODE switch in the CHOP state or the ALT state. By using these modes signals can be successfully displayed with sweeps at all sweep speeds.

(1) CHOP sweep (chopped sweep):
The signals of CH1 and CH2 are chopped at a frequency of 500 kHz and the chopped signals are displayed on the CRT screen. Therefore, if the sweep speed becomes as dotted lines, the ALT mode should be used.

(2) ALT sweep (alternate sweep)
This sweep mode is used primarily for observation of signals at faster sweep speeds, although it may be used also at slower sweep speeds when photographing the displayed waveforms or when particular trigger conditions are required.

At faster sweep speeds, the two waveforms are displayed as if they were running at the same time. At slower sweep speeds, the alternate actions of the two sweeps becomes discernible to human eyes and the displayed images flicker. In this case, the CHOP mode explained in the preceding paragraph should be used.

4.3 ADD Operation

An algebraic sum of the CH1 and CH2 signals can be displayed on the CRT screen by setting the VERT MODE switch in the ADD state. The displayed signal is the difference between CH1 and CH2 signals if the CH2 POLARITY switch is set in the ▬ INV state.

For accurate addition or subtraction, it is a prerequisite that the sensitivities of the two channels are adjusted accurately at the same value by means of the VAR knobs. Vertical positioning can be done with the ↕ POSITION knob of either channel. In view of the linearities of the vertical amplifiers, it is most advantageous to set them in their mid-positions.

4.4 Triggering

Proper triggering is essential for efficient operation of an oscilloscope. The user of the oscilloscope must make himself thoroughly familiar with the triggering functions and procedures.

(1) Functions of INT TRIG (internal trigger) switch:

The signals applied to the input terminals of CH1 and CH2 are picked off from respective preamplifiers in order to be used as internal trigger signals. The INT TRIG switch selects these signals. The selected signals are sent to the A trigger circuit or the B trigger circuit through the SOURCE switch. The relationship of these circuits is shown in the block diagram of Figure 4.

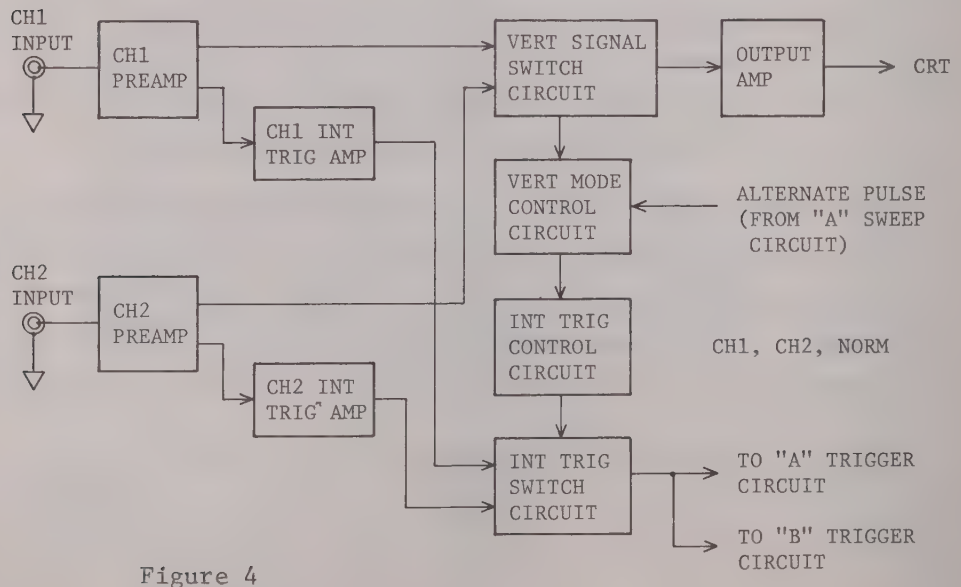


Figure 4

With the INT TRIG switch the internal trigger signal can be selected as follows.

CH1: Input signal of CH1

CH2: Input signal of CH2

NORM: Signal being displayed on CRT when in ALT mode

For further claritication see the following table.

INT TRIG \ VERT MODE	CH1	CH2	CHOP	ALT	ADD	X-Y
CH1	Triggered with CH1					
CH2	Triggered with CH2					
NORM	Triggerd with CH1	Triggerd with CH2	-	*Alter-nate trigger	Triggerd with CH1	-

* Because the trigger circuit receives both input signals it is necessary to consider the DC level of both when in the ALT trigger mode.

(2) Functions of SOURCE Switch:

To display a stationary pattern on the CRT screen, the displayed signal itself or a trigger signal which has a time relationship with the displayed signal is required to be applied to the trigger circuit. The SOURCE switch selects such a trigger source.

INT: This internal trigger method is used most commonly. The signal applied to the vertical input terminal (the measured signal) is branched off from a point in the amplifier circuit and is fed to the trigger circuit through the INT TRIG switch. Since the trigger signal is the measured signal itself, a very stable waveform can be readily displayed on the CRT screen.

LINE: The AC power line frequency signal is used as the trigger signal. This method is effective when the measured signal has a relationship to the AC line frequency, especially for measurements of low level AC noise of audio circuits, AC line frequency controlled thyristor circuits, etc.

EXT: The sweep triggered with an external signal applied to the EXT TRIG INPUT terminal. An external signal which has a periodic relationship with respect to the measured signal is used. Since the measured signal (vertical input signal) is not used as the trigger signal, waveform display can be done independent of the measured signal.

EXT ÷ 10: The external trigger signal applied to the EXT TRIG INPUT terminal is attenuated into 1/10 before being applied to the trigger circuit. Operation is the same with those of the EXT trigger mode. This mode is used when the external trigger signal level is too high.

(3) Functions of COUPLING switch:

This switch is used to select the coupling of the trigger signal to the trigger circuit in accordance with the characteristics of the measured signal.

AC: This coupling is for AC triggering which is used most commonly. As the trigger signal is applied to the trigger circuit through an AC coupling circuit, stable triggering can be attained without being affected by the DC component of the input signal. The low-range cut off frequency is 3 Hz (-3 dB).

When the ALT trigger mode is used and the sweep speed is slow, jitter may be produced. In such a case, use the DC mode.

HF REJ: The trigger signal is applied to the trigger circuit through an AC coupling and a low pass filter circuit,

in order that the high frequency signal or noise components of the trigger signal is eliminated triggering is effected by the low frequency component alone.

TV: This coupling is for TV triggering for observation of TV video signals. The trigger signal is AC-coupled and fed via the trigger circuit (level circuit) to the TV sync separation circuit. The separation circuit picks off the sync signal and this is used to trigger the sweep. Thus, the video signal can be displayed very stably.

Being linked to the TIME/DIV switch, the sweep speed is switched for TV.V and TV.H as follows:

TV.V: 0.5 sec - 0.1 msec
TV.H: 50 μsec - 0.1 μsec

The SLOPE switch should be set in conformity with the video signal as shown in Figure 5.

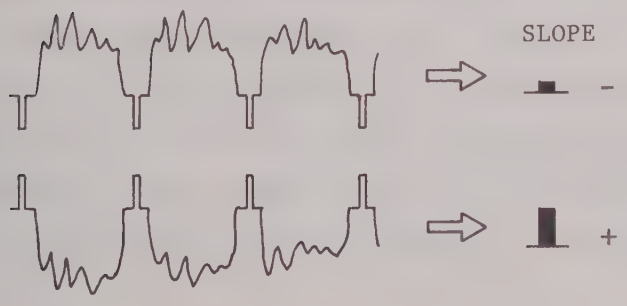


Figure 5

Note: The LEVEL LOCK is effective when the signal level is very low (2 DIV or less). When the signal level is higher than 2 DIV, release the LOCK and manually adjust the level.

DC: The trigger signal is DC-coupled to the trigger circuit. This mode is used when triggering is desired on the DC component of the trigger signal or when a very low frequency signal or a signal of a large duty cycle ratio is required to be displayed.

(4) Functions of SLOPE switch:

This switch selects the slope (polarity) of the trigger signal.

"+": When set in the "+" state, triggering occurs as the trigger signal crosses the trigger level in the positive-going direction.

"-": When set in the "-" state, triggering occurs as the trigger signal crosses the trigger level in the negative-going direction.

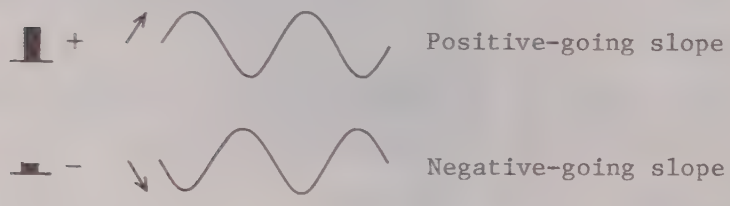


Figure 6

(5) Functions of LEVEL (LOCK) control:

The function of this control is to adjust the trigger level and display a stationary image. At the instant the trigger signal has crossed the trigger level set by this control, the sweep is triggered and a waveform is displayed on the screen.

The trigger level changes in the positive direction (upward) as this control knob is turned clockwise and it changes in the negative direction (downward) as the knob is turned counter-clockwise. The rate of change is set as shown in Figure 7.

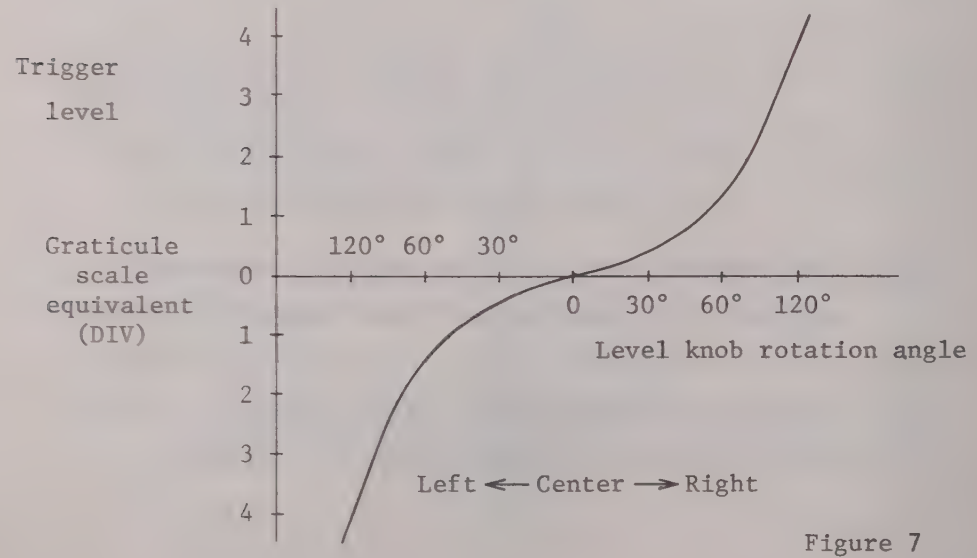


Figure 7

o LEVEL LOCK

When the LEVEL knob is set in the LEVEL LOCK position, the trigger level is automatically maintained at a stable trigger level by the level lock circuit, provided that the displayed signal level or the external trigger signal level is within the following range:

3 Hz - 35 MHz	1.5 DIV (0.15 V)
10 Hz - 10 MHz	0.9 DIV (0.09 V)

(6) Functions of A HOLD OFF control:

When the measured signal is a complex waveform with two or more repetition frequencies (periods), triggering with the above-mentioned LEVEL control alone may not be sufficient for attaining a stable waveform display. In such a case, the sweep can be synchronized to the measured signal waveform by adjusting the HOLD OFF time (sweep pause time) of the sweep waveform. The control covers at least the time of one full sweep, for sweeps faster than 0.2 sec/DIV.

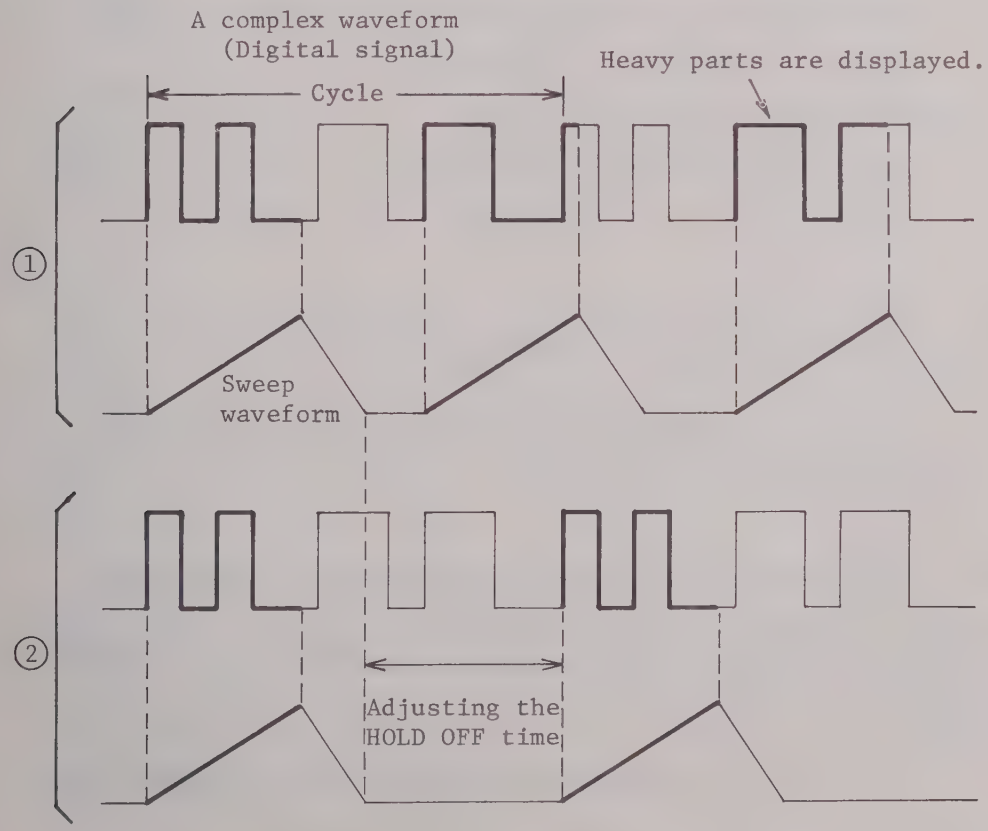


Figure 8

4.5 Single-sweep Operation

For photographic applications this mode is sometimes most preferable.

- Measurement of non-repetitive signal:

  (1) Set the HORIZ DISPLAY in the "A" state and the SWEEP MODE in the NORM state.

  (2) Applied the measured signal to the vertical input terminal and adjust the trigger level.

  (3) Set the SWEEP MODE in the SINGLE state (the three push-button switches are pushed out).

  (4) Depress the RESET button. The sweep will run for one cycle alone and the measured signal will be displayed only once for the corresponding period.

- Measurement of one-shot signal:

  (1) Set the HORIZ DISPLAY in the "A" state and the SWEEP MODE in the NORM state.

  (2) Apply the calibration output signal to the vertical input terminal, and adjust the trigger level at a value corresponding to the predicted amplitude of the measured signal.

  (3) Set the SWEEP MODE in the SINGLE state. Apply the measured signal instead of the calibration signal to the vertical input terminal.

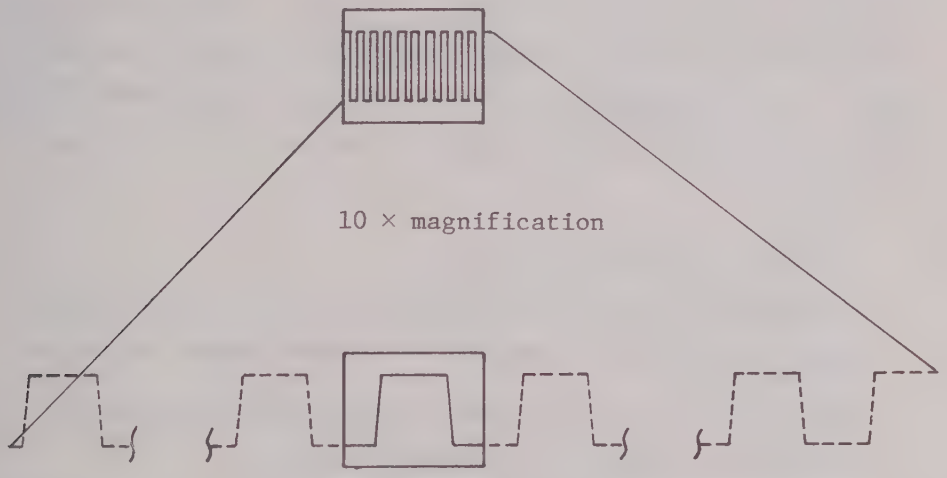
  (4) Depress the RESET button. The sweep circuit will become the ready state and the READY lamp will turn on.

  (5) As the one-shot signal occurs in the input circuit, the sweep runs for one cycle and the one-shot signal is displayed on the CRT screen.

The single-sweep operation can be done also with A INTEN and B sweep. However, it cannot be done in the ALT mode dual-channel operation. For dual-channel one-sweep operation, use the CHOP mode.

4.6 Sweep Magnification

Wnen a certain part of the displayed waveform is required to be expanded timewise, a faster sweep speed may be used. However, if the required part is apart from the start point of the sweep, the required part may run off of the CRT screen. In such a case, set the "10 × MAG" switch (39) in the ▬ 10 × MAG state. When this is done, the displayed waveform is expanded by 10 times to right and left with the center of screen as the center of expansion.



Any part can be covered by means of POSITION control.

Figure 9

The sweep time when in the magnification operation is as follows:

(Value indicated by TIME/DIV switch) × 1/10

Thus, the maximum sweep speed (0.1 μsec/DIV) can be made faster with magnification as follows:

0.1 μsec/DIV × 1/10 = 10 nsec/DIV

When the sweep is magnified and the sweep speed has become faster than 0.1 sec/DIV, the trace intensity may be reduced. In such a case, the displayed waveform should be expanded in the B sweep mode explained in the subsequent paragraphs.

4.7 Waveform Magnification with Delayed Sweep

With sweep magnification of the preceding paragraph, although the magnification method is simple, the magnification ratio is limited at 10. With the delayed sweep method of this paragraph, on the other hand, the sweep can be expanded for a wide range of from several times to several thousand times according to the ratio between A sweep time and B sweep time.

As the measured signal frequency becomes high and the A sweep range for the non-expanded signal becomes higher, the available expansion ratio becomes smaller. Further, as the magnification ratio becomes larger, the trace intensity becomes lower and the delay jitter increases. To cope with these situations, a triggered delay action circuit and a B ENDS A action circuit also are incorporated.

(1) Continuously-variably delay:

Set the HORIZ DISPLAY switch to A and display the signal waveform with the A sweep in the regular operation method.

Next, set the B TIME/DIV switch in a position faster by several steps than the A TIME/DIV switch.

After ensuring that the ▬ B TRIG'D switch is in the ▮ OFF state, turn the HORIZ DISPLAY switch to the A INTEN position. A part of the displayed waveform will be accentuated as shown in Figure 10. The part of the accentuated brightness denotes the section correspoding to the B sweep time (DELAYED SWEEP). This part is expand on the B sweep.

The period from the start of the A sweep to that of the B sweep (the period to that the trace is accentuated) is called "SWEEP DELAY TIME". This period is continuously variable by means of the DELAY TIME MULTI dial.

Next, change the HORIZ DISPLAY switch to the B position. The B sweep time will be expanded for the full span of the CRT screen as shown in Figure 11.

The B sweep time is set by the B TIME/DIV switch and the magnification ratio becomes as follows:

$$\text{Magnification ratio} = \frac{\text{A TIME/DIV indication}}{\text{B TIME/DIV indication}}$$

The sweep delay time can be read on the CRT screen. For more accurate determination, the DELAY TIME MULTI dial should be used.

$$\text{Sweep delay time} = \text{A TIME/DIV indication} \times \text{DELAY TIME MULTI dial setting}$$

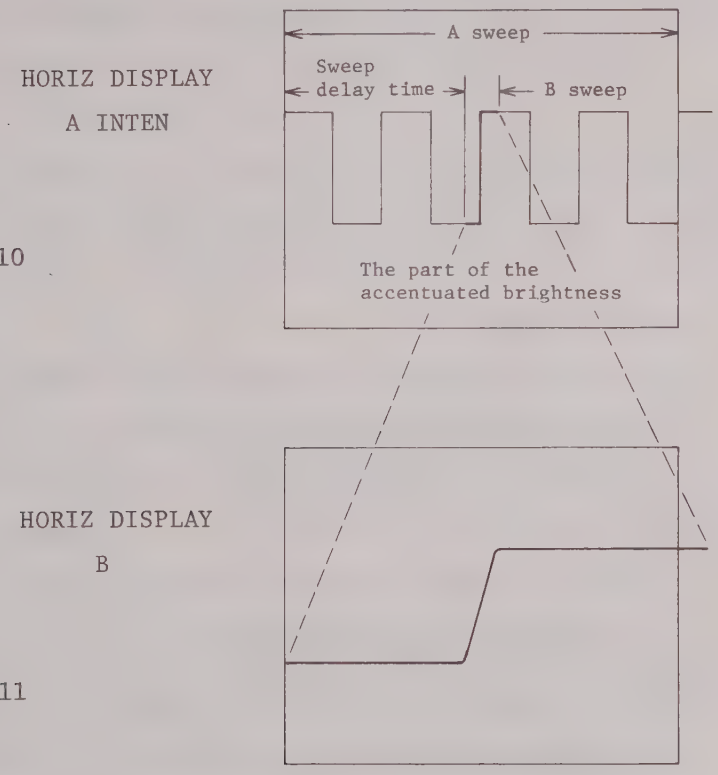


Figure 10

Figure 11

(2) Synchronized delay:

When the displayed waveform is magnified by 100 times or over in the above-mentioned continuous delay method, delay jitter is produced. To suppress the jitter, this synchronized delay method may be used.

With the synchronized delay, delay jitter is reduced by triggering the B sweep again after a sweep delay time as effected by the continuous delay method has elapsed.

For this operation, the B trigger circuit operates as the ▬ B TRIG'D (49) switch is set in the ▬ ON state and the B sweep is triggered by the B trigger pulse. Therefore, even when the delay time is continuously varied by rotating the DELAY TIME MULTI dial, the starting point does not vary continuously but varies intermittently. This operation in the A INTEN can be

observed as the accentuated section moves intermittently; however, the B sweep will appear to remain stationary.

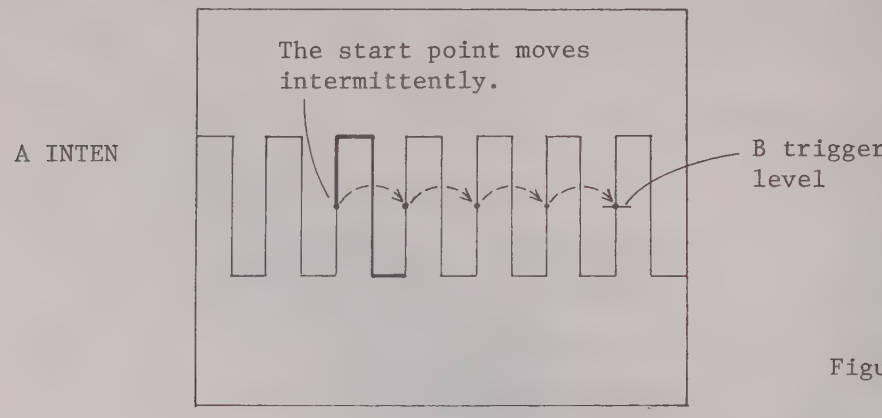


Figure 12

4.8 Delayed ALT Sweep

When in the Delayed ALT sweep mode, the A sweep and B sweep (delayed sweep) are displayed alternately on the screen, enabling you to observe at the same time the unmagnified waveform and magnified waveform of Section 4.7.

The operation method is the same as that of the delayed sweep of Section 4.7. As you turn the HORIZ DISPLAY switch to the ALT position, the A INTEN waveform and B waveform are displayed on the screen as shown in Figure 13. To prevent the two waveforms from overlapping and to display them separately, adjust the A, B TRACE SEPARATION potentiometer (34) .

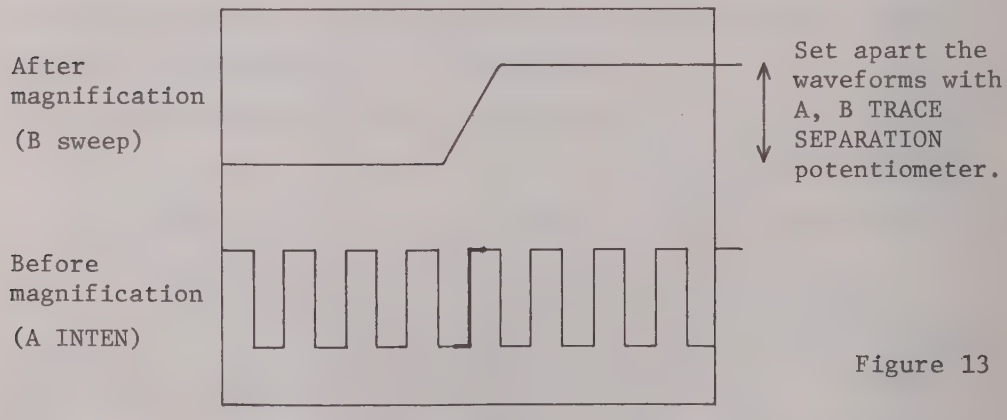

After magnification (B sweep)
Before magnification (A INTEN)
Set apart the waveforms with A, B TRACE SEPARATION potentiometer.

Figure 13

Note: The delayed ALT sweep mode can be used in combination with the dual-channel mode (CHOP or ALT) of the vertical axes.

4.9 B ENDS A Mode

When the trace is magnified by a large ratio with the delayed sweep, the magnified trace may become dim and hardly discernible. This is because, the slow A sweep runs for the full screen, before the B sweep can recieve A trigger signal. This causes most of the CRT beam current to be diverted to the A sweep display. By ending the A sweep at the minimum required point, the display time for the B sweep is increased so that the trace does not become dark. This is the B ENDS A mode.

The operating method is the same with that of Sections 4.8 and 4.9. Turn the A HOLD OFF knob (31) to the extreme clockwise position (B ENDS A position). A bright magnified trace as shown in Figure 14 will be displayed.

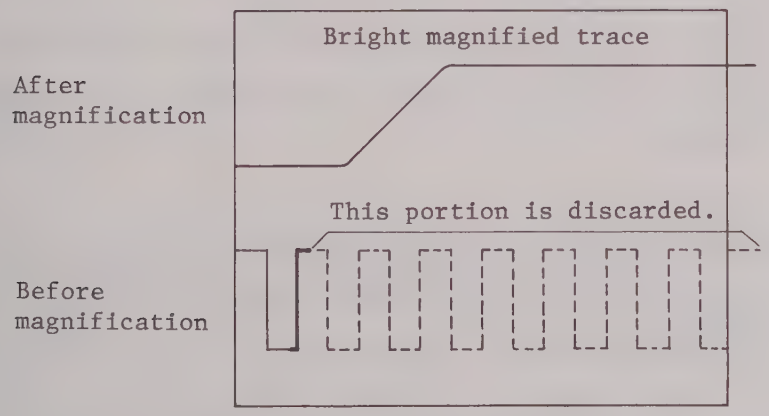


Figure 14

5.1 Connection Method of Input Signal

The input impedance of the oscilloscope as viewed from the vertical input terminal is 1 MΩ with capacitance approximately 20 pF in parallel. When the probe 10:1 is used, the impedance increases to resistance 10 MΩ with capacitance approximately 12 pF in parallel.

There are various methods of connection between measured signal source and oscilloscope. The most popular methods are with a probe, or with a coaxial cable. Suitable ones are used taking the following factors into consideration.

Output impedance of input signal source
Level and frequency of input signal
External induction
Distance between input signal source and oscilloscope

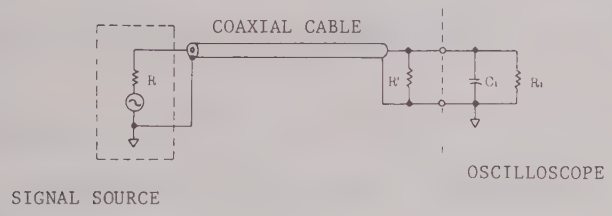
Types of input signals and connection methods are tabulated in the following:

Type of input signal / Connection method			Probe	Coaxial cable
Low frequency	Low impedance	Near	○	○
		Far		○
	High impedance	Near	○	◍
		Far		◍
High frequency	Low impedance	Near	○	○
		Far		○
	High impedance	Near	○	◍
		Far		

(○: Good, ◍: Fair)

o Connection with coaxial cable:

When the output impedance of the signal source is 50Ω or 75Ω, the input signal can be fed without attenuation up to high frequencies by using a coaxial cable which enables impedance matching. For impedance matching, terminate the coaxial cable with a 50Ω or 75Ω pure-resistive resistor corresponding to the characteristic impedance of the coaxial cable, as shown in Figure 15.



R = R'

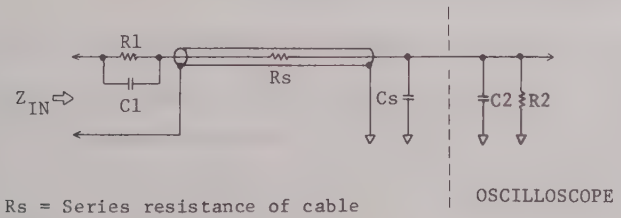
When R = 50 Ω, use a 50 Ω coaxial cable.

When R = 75 Ω, use a 75 Ω coaxial cable.

Figure 15

o Connection with probe:

A probe with an attenuation ratio of 10:1 is available as supplied. The probe circuit and probe cable are shielded to prevent induction noise. The probe circuit makes up a wide-range attenuator in conjunction with the input circuit of the oscilloscope, thereby enabling a distortionless connection from DC to high frequencies. When the probe is used, although the signal level is attenuated to 1/10, the input impedance becomes very high (resistance 10 MΩ, capacitance approx. 12 pF) and the loading effect on the measured signal source is greatly reduced as explained in the following.



Rs = Series resistance of cable

Cs = Stray capacitance plus cable capacitance

Figure 16

The probe makes up a wide-range attenuator with its resistor R1 which make up an attenuator circuit with respect to input resistor R2 of the oscilloscope and with its capacitor C1 which compensates for input capacitor C2 of the oscilloscope and stray capacitance (Cs) of the cable. The input impedance Z_{IN} is expressed as follows:

$$Z_{IN} = \frac{R1 + R2}{C\ (R1 + R2) + 1}$$

$$C = \frac{C1 \times (C2 + Cs)}{C1 + C2 + Cs}$$

Attenuation ratio A is expressed as follows:

$$A = \frac{R2}{R1 + R2} \quad \left(= \frac{1\ M\Omega}{9\ M\Omega + 1\ M\Omega} = \frac{1}{10} \right)$$

The terms enclosed in the parentheses are for the factor when the probe is used:

Precautions:

- o Observe the maximum allowable input voltages mentioned in Section 3.4.
- o Do not fail to use the ground lead supplied.
- o Before commencing measurement, accurately adjust the frequency compensation of the probe without fail.
- o Do not apply unreasonably large mechanical shocks or vibration to the probe. Do not sharply bend or strongly pull the probe cable.
- o The probe unit and tip are not highly heat resistant. Do not apply a soldering iron to a circuit close to the point where the probe is left hooked up.
- o If a 1 × probe is used the bandwidth is severely limited due to the increased tip capacitance. This may load a circuit enough to significantly effect its operation.

5.2 Voltage Measurement

To measure an AC signal which has no DC component or to measure the AC component alone of a signal which has a DC componenet superimposed on the AC component, set the vertical input AC/DC selector switches (8) and (16) in the AC position. To measure the DC componenet of a signal, set the switch in the DC position.

Before commencing voltage measurement, set the VARIABLE attenuator knobs (6) and (14) at the CAL position and calibrate the sensitivity to the value indicated by the VOLTS/DIV selector switches (5) and (13).

Apply the signal to be measured, display the signal with an appropriate amplitude on the screen, and determine the amplitude on the graticule. (For DC voltage measurement, determine the shifted distance of the trace.) The voltage can be determined as follows:

(1) When measured signal is directly applied to input terminal:

Voltage (V) = Deflection amplitude (DIV) × Indication of VOLTS/DIV switch

(2) When the 10:1 probe is used:

Voltage (V) = Deflection amplitude (DIV) × Indication of VOLTS/DIV switch × 10

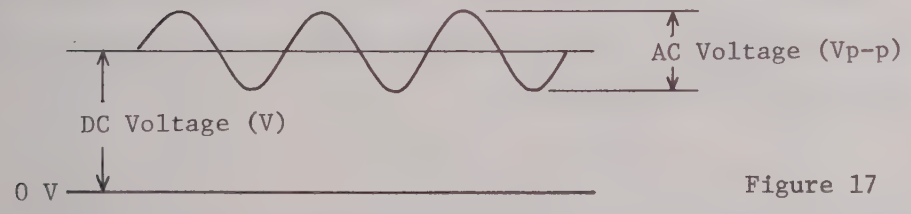


Figure 17

5.3 Current Measument (voltage drop method)

Connect a small resistor (R) in series in the circuit in which the current (I) to be measured flows and measure the voltage drop across the resistor with the oscilloscope. The current is known from Ohm's law as follows:

$$I = \frac{E}{R} \quad (A)$$

The resistance should be as small so that it does cause change to the measured signal source.

In the above method, currents from DC to high frequencies can be measured quite accurately. Note that the accuracy of the resistor reflectes upon the measuring accuracy.

5.4 Time Measurement

Measurement of time interval

The time interval between any two points on the displayed waveform can be measured by setting the TIME/DIV VARIABLE knob (44) in the CAL position and referring to the indication of the TIME/DIV switch (45).

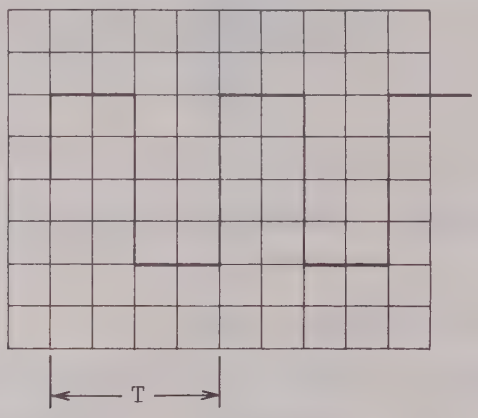


Figure 18

Time T (sec) = Indication of TIME DIV × Horizontal span (DIV)

When the sweep is magnified (10 × MAG (39)), the time is 1/10 of the value determined as above.

5.5 Frequency Measurement

- Frequency measurement by determining time (T) per one cycle of the displayed waveform:

  Time T (period) is measured as explained in section 5.4 and the frequency is known by using the following formula.

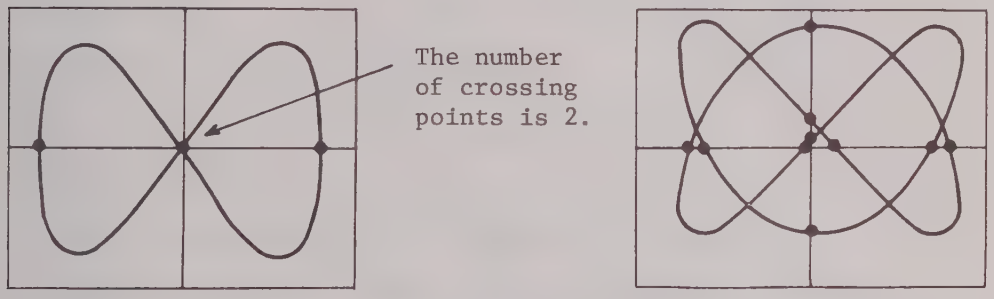
$$\text{Frequency } f \text{ (Hz)} = \frac{1}{\text{Period } T \text{ (sec)}}$$

- Frequency measurement with Lissajous figure (See Figures 19 and 20):

  Set the VERT MODE switch 1 in the X-Y state so that the oscilloscope operates in the X-Y mode.

Apply to the X-axis a known frequency from a signal generator (SG) and to the Y-axis the frequency to be measured. So adjust the required controls that a pattern is displayed on the full surface of the CRT screen. Then so adjust the frequency of the signal generator that the displayed pattern becomes stationary as shown in Figure 18. From the displayed waveform, the unknown frequency can be calculated as follws:

$$\text{Unknown Frequency (Hz)} = \frac{\text{The number of crossing points over horizontal scale line}}{\text{The number of crossing points over vertical scale line}} \times \text{Frequency of signal generator (Hz)}$$



$$\frac{4}{2} = \frac{2\ (H)}{1\ (V)} \qquad \frac{6}{4} = \frac{3\ (H)}{2\ (V)}$$

Figure 19

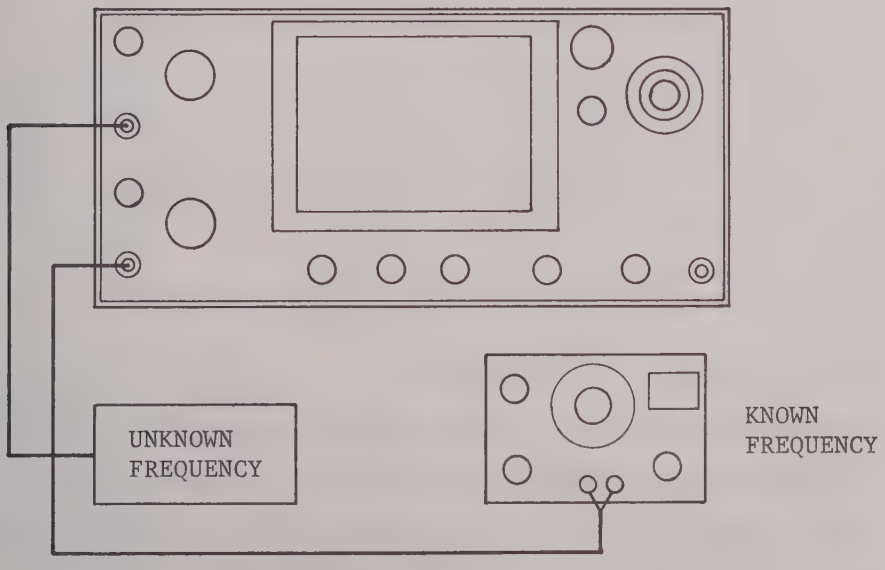


Figure 20

5.6 Measurement of Phase Difference

o Measurement of phase difference with Lissajous figure (See Figures 20, 21 and 22):

Operate the oscilloscope in the X-Y mode as explained in the paragraph for frequency measurement, and apply two signals of the same frequency (such as stereophonic signals) to the X and Y axes so that a Lissajous figure is displayed on the CRT screen. The phase difference between the two signals can be known by measuring the displayed waveform and employing the following equation:

$$\text{Phase difference } \theta = \sin^{-1} \frac{B}{A}$$

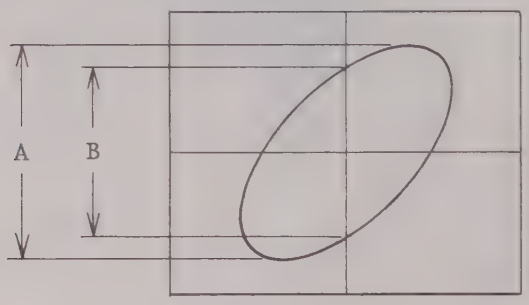


Figure 21

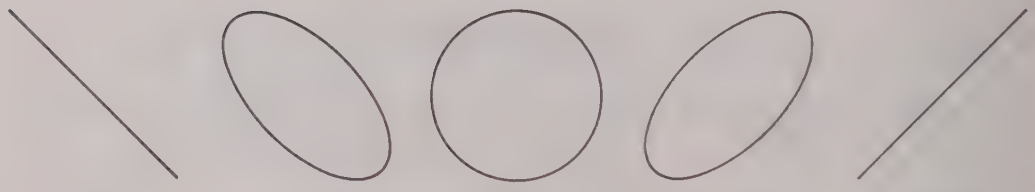


Figure 22

5.7 Characteristics of Pulse Waveform

A theoretically ideal pulse waveform is such that the signal changes instantaneously from one level to another, held in this level for a period of time and returns instantaneously to the original level. However, actual pulse waves are distorted. Nomenclature of distortions is given in Figure 23.

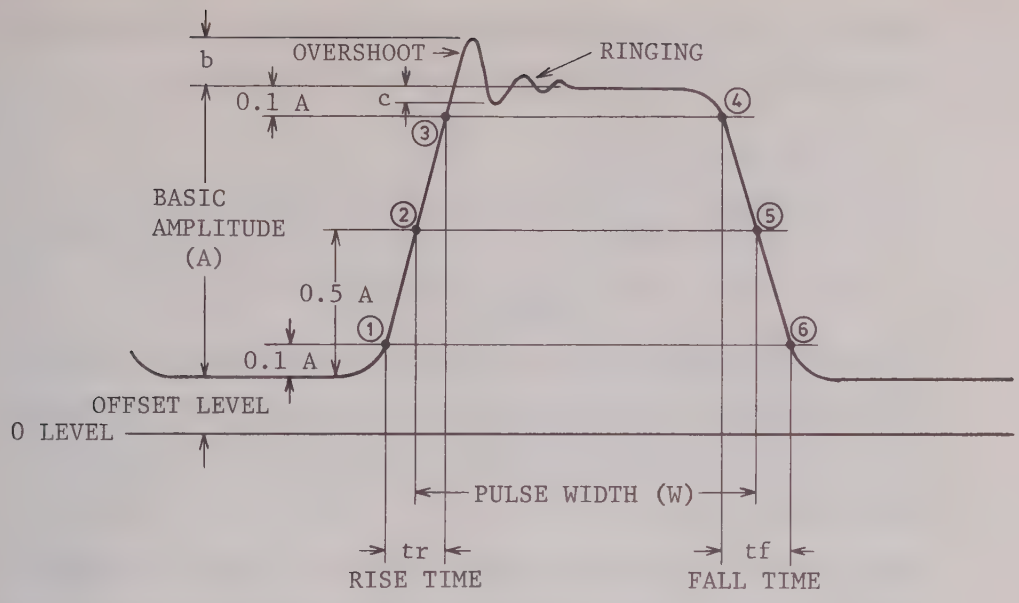


Figure 23

Pulse amplitude:	Basic amplitude (A) of pulse
Pulse width:	Time between points ② and ⑤ where signal amplitude is 50% of basic amplitude
Rise time:	Time between 10% basic amplitude point ① and 90% basic amplitude point ③
Fall time:	Time between 90% basic amplitude point ④ and 10% basic amplitude point ⑥
Overshoot:	Amplitude of the first maximum excursion beyond basic amplitude. Expressed in terms of b/A × 100 (%)
Ringing:	Oscillation which follows the first maximum excursion. Expressed in terms of c/A × 100 (%)

o Measurement of rise time:

The rise time of a pulse can be known by determining the value of t_r on the CRT screen in the method of "Time Measurement." It must be noted that t_r determined on the CRT screen includes the rise time of the oscilloscope itself. The closer the rise time of the oscilloscope (t_o) to the rise time of the measured

pulse (t_n), the larger is the error introduced. To eliminate this error, calculation should be done as follows:

$$\text{True rise time } t_n = \sqrt{(t_r)^2 - (t_o)^2}$$

where, t_r: Rise time measured on CRT screen

t_o: Rise time of oscilloscope itself (approx. 10 nsec)

For example, when a pulse wave with rise time 30 nsec (about 3 times of that of the oscilloscope) is measured on the CRT screen, the error is approximately 6%.

o Measurement of Sag

Pulse waveforms may have slanted sections as shown in Figure 24, other than those distortions mentioned in Figure 23. (For example, slants are caused when the signal is amplified with an amplifier which has poor low-frequency characteristics, resulting from attenuation of low frequency components.) The slanted section (d or d') is called "sag" which is calculated as follows:

$$\text{Sag} = \frac{d}{A} \left(\text{or } \frac{d'}{A'}\right) \times 100\ (\%)$$

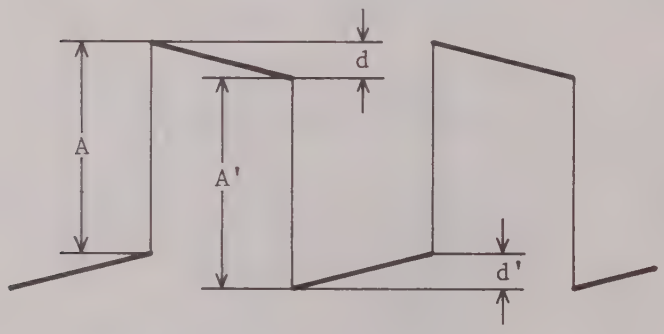


Figure 24

Note: If the AC-coupling mode is used for measurement of a low frequency pulse, sag is caused. For measurement of low frequency pulses, use always the DC-coupling mode.

6. CIRCUIT DESCRIPTION

6.1 General

The overall circuit structure of the 5630 is as depicted with a block diagram in Figure 25. It is comprised of a vertical deflection circuit for moving the beam spot in the Y-axis direction on the CRT screen, a horizontal deflection circuit for moving the beam spot in the X-axis direction, a CRT circuit for operating the cathode-ray tube, a calibrator circuit for calibrating the instrument probe, and a power supply circuit for supplying powers to the various circuits of the instrument.

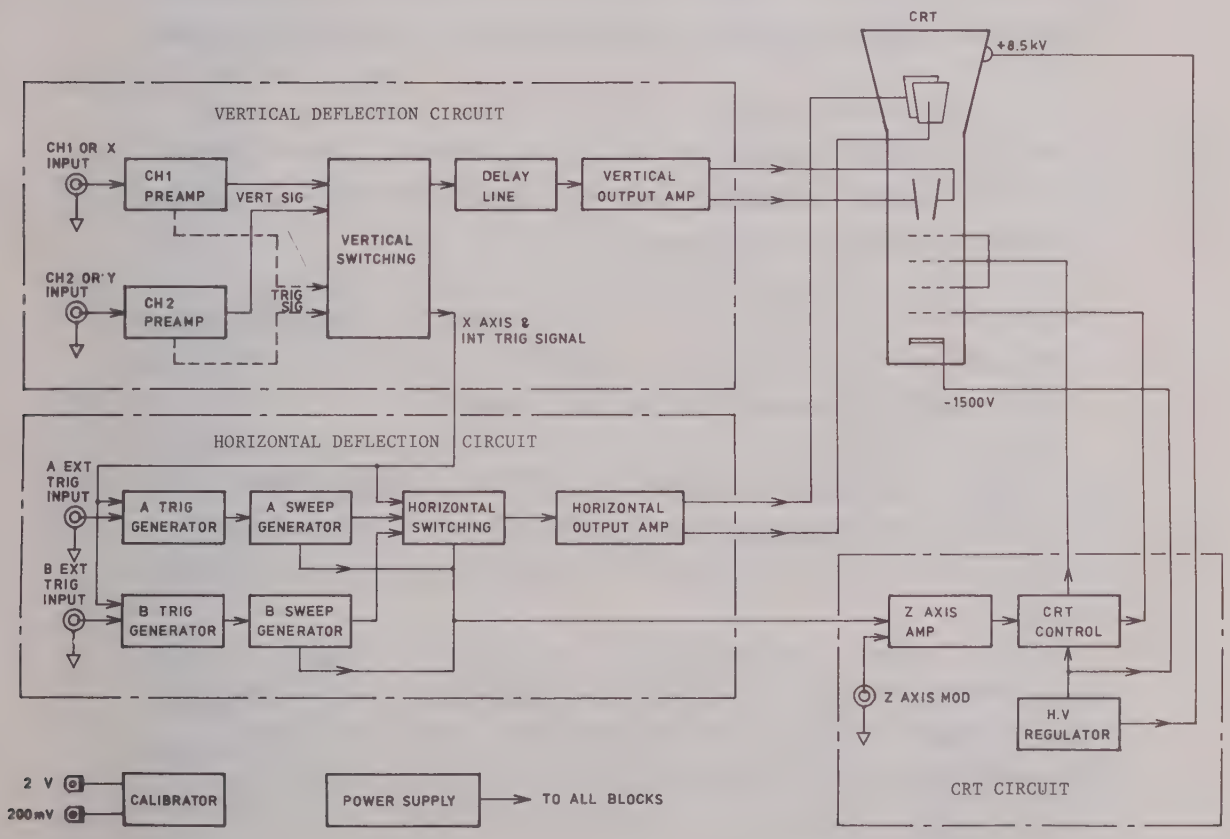


Figure 25

The vertical amplifier circuit has two mutually independent preamplifiers (CH1 and CH2), a vertical switching circuit, a delay line, and a vertical output amplifier.

Each of the preamplifiers amplifies or attenuates its input signal of several millivolts to several hundreds volts into a level suitable for handling by the subsequent stage. The conditioned vertical signals are sent to the vertical switching circuit. The trigger signals also are picked off at this stage.

The vertical switching circuit electronically switches the vertical signals sent from the CH1 and CH2 preamplifiers. The switched signal is fed via the delay line circuit to the vertical output amplifier. The trigger signals also are switched and fed as internal trigger signals to the A & B trigger generators or as X-axis signals to the horizontal switching circuit.

The vertical output amplifier amplifies the vertical signal, which is received through the delay line circuit, into a level of several volts to several tens volts for vertically deflecting the beam spot on the CRT screen.

The horizontal deflection circuit has mutually independent A and B trigger generators and sweep generators, a horizontal switching circuit, and a horizontal output amplifier.

The trigger generator receives the internal trigger signal from the vertical switching circuit or an external trigger signal from the EXT TRIG INPUT terminal and generates a trigger pulse signal.

The A sweep generator is driven by the trigger pulse signal of the A trigger generator and produces the A sawtooth signal. The sweep generator produces a sawtooth signal even when no trigger pulse is applied to it (the AUTO mode).

The B sweep generator produces the B sawtooth signal, being driven by the delayed sweep start signal produced with respect to the A sawtooth signal when in the delayed sweep mode. The B sweep generator can also be driven by the trigger pulse signal of the B trigger generator which follows the above delayed sweep start signal (the B TRIG'D mode).

The horizontal switching circuit electronically switches the sawtooth signals received from the A and B sweep generators and the X-axis signal received from the vertical switching circuit, and sends the resultant signal to the horizontal output amplifier.

The horizontal output amplifier amplifies the output signal of the horizontal switching circuit to a level of several volts to several tens volts in order to drive horizontally the beam spot on the CRT screen.

The CRT circuit is comprised of a high voltage generator (the HV regulator) to accelerate the electron beam emitted from the CRT cathode, a Z-axis amplifier to amplify the signal to blank out the return traces, and a CRT control circuit to operate the CRT tube in its optimal state.

The HV regulator provides a -1.5 kV voltage which is applied to the CRT cathode to accelerate the electrons emitted by it and a +8.5 kV voltage which is used as a post-acceleration voltage to accelerate further the electrons after passing the vertical and horizontal deflection plates.

The Z-axis amplifier amplifies the unblanking signals received from the A and B sweep generators and the trace intensity control signal to a level of several tens volts in order to be applied to the 1st grid (control grid) of the CRT via the CRT control circuit.

The CRT control circuit provides the various voltages for the CRT electrodes so that the CRT operates in an optimal state, displaying sharply-focussed less-distorted signal waveforms. It also conditions the signals received from the Z-axis amplifier and other circuit into levels suitable for application to the CRT.

6.2 CH1 and CH2 Preamplifiers

The CH1 and CH2 preamplifiers amplify the signals of the CH1 (X-axis) input and CH2 (Y-axis) terminals, respectively. A block diagram of these preamplifiers are shown in Figure 26.

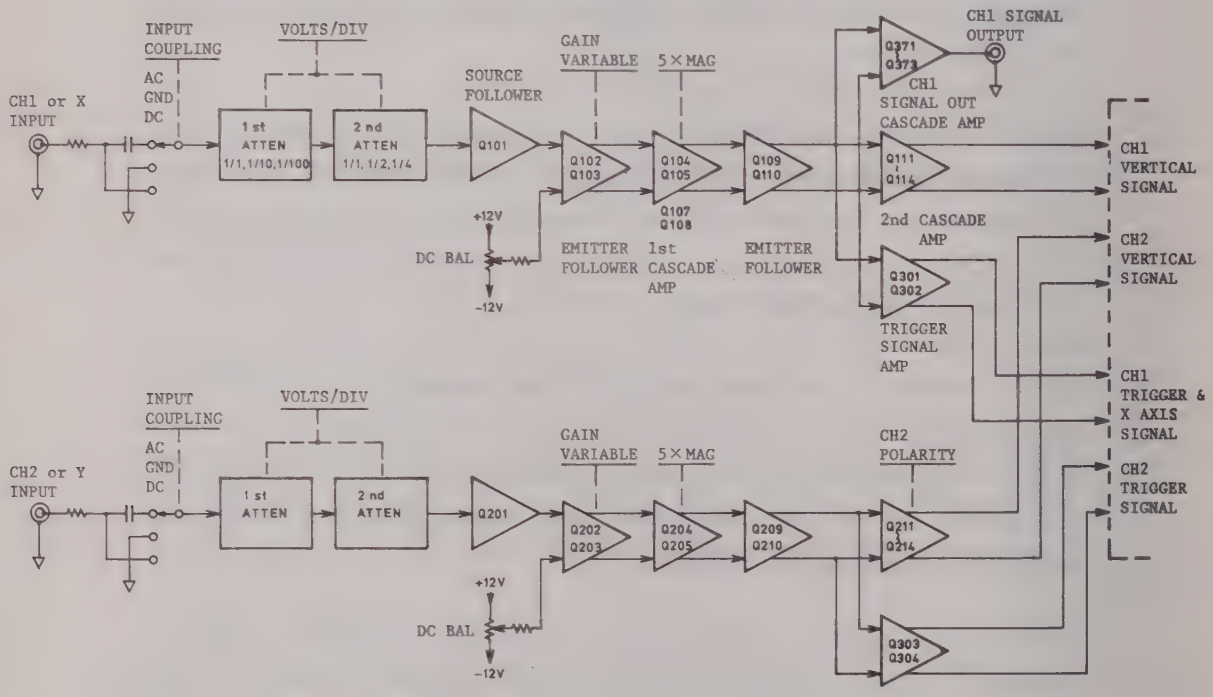


Figure 26

o Input coupling switch:

The input coupling switch (SW101/201) selects the input coupling mode for AC, GND, or DC. When the GND state is selected, the preamplifier input is isolated from the input terminal and is grounded so that the base line (0 level) on the CRT screen can be checked.

o Attenuators:

The attenuator circuit consists of two attenuators: the 1st attenuator for 1/1, 1/10 and 1/100, and the 2nd attenuator for 1/1, 1/2, 1/4 and 1/10. By combinations of these attenuators with the VOLTS/DIV switch (SW102/202), the signal can be attenuated for a total range of 1/1 to 1/1000 in 10 steps. The attenuator circuit is so designed that its input impedance remains constant at 1 MΩ, 20 pF (±2 pF) even when combinations are changed.

o Impedance converter:

The impedance converter presents with its source follower (Q101/201) a high input impedance to prevent the loading effect on the high-impedance attenuator circuit and provides a low output impedance with its emitter follower (Q102, 103/202, 203) to drive the 1st differential cascade amplifier of the next stage. In order to guard against thermal drift, the source follower employs a dual-FET package which houses two thermally-coupled elements for thermal drift compensation and the emitter follower employs two premium-grade thermally-coupled transistors.

o 1st differential cascade amplifier:

The 1st differential cascade amplifier is comprised of an emitter-connected differential current amplifier (Q104, 105/204, 205) and a current-to-voltage converter (Q107, 108/207, 208) which converts the differential collector output current of the differential

current amplifier into a voltage signal. This amplifier also has the VARIABLE circuit for continuously-variable adjustment of the sensitivity between two adjoining vertical deflection sensitivity ranges selected by the VOLTS/DIV switch and the 5 × MAG switch for magnifying the vertical sensitivity by 5 times to realize the 1 mV/DIV sensitivity.

o VARIABLE circuit:

The VARIABLE circuit continuously-variably adjusts the vertical sensitivity by shunting with potentiometer R128/228 a part of the collector current amplified by Q104, 105/204, 205. Adjustment (attenuation) can be done with a ratio of 1/2.5 or over.

o 5 × MAG circuit:

The 5 × MAG function is to increase the vertical sensitivity by 5 times by switching the output load resistor of the 1st differential cascade amplifier to the value of 5 times of that when in the normal mode, with the diode switching circuit (CR102 - 105/202 - 205). The diode switching circuit is DC-controlled by the 5 × MAG switch (S302/304).

o Buffer emitter follower:

The buffer (Q109, 110/209, 210) has a function of sending, with less loading effects, the output signal of the preceding 1st differential cascade amplifier to the subsequent 2nd differential cascade amplifier, trigger signal pickoff amplifier, and CH1 SIGNAL OUTPUT amplifier (CH1 only).

o 2nd differential cascade amplifier:

The 2nd differential cascade amplifier (Q111 - 114/Q211 - 216) amplifies the output of the emitter follower to a sufficient level for driving the vertical switching circuit. The grounded-base stage (Q113, 114/213, 214) of this cascade amplifier has a

function of preventing the switching signal of the vertical switching circuit from being returned to the preceding stage and mixed into the trigger signal or the signal of the CH1 SIGNAL OUTPUT amplifier. For the CH2 signal, this amplifier also has a function of inverting its polarity. This polarity switching function is accomplished by mutually corssing the amplified collector currents of Q211 and Q212 and switching by the POLARITY switch (S305) the grounded-base stage circuits of Q213, 216 and Q214, 215 the collectors of which are connected to the collectors of Q211 and Q212.

Different from the case of the 1st differential cascade amplifier, the output signal of the 2nd differential cascade amplifier is fed directly in the form of the current signal to the diode gate of the vertical switching circuit. The current signal for vertical positioning of the trace on the CRT screen is added to the output current signal of the 2nd differential cascade amplifier, being controlled by potentiometer R176/276 of the positioning circuit.

o CH1 SIGNAL OUTPUT amplifier (CH1 only):

The CH1 SIGNAL OUTPUT amplifier (Q371, Q372, Q373) amplifies the input signal of the CH1 (X INPUT) terminal by approximately 5 times (2.5 times when terminated with 50 ohms). The amplified signal is fed to the output terminal (J-86) on the instrument rear panel in order to be monitored with a frequency counter or other measuring instrument.

6.3 Vertical Switching Circuit

The vertical switching circuit is comprised of a vertical signal switching circuit which electronically switches the CH1 and CH2 vertical preamplifier output signals, an internal trigger signal

switching circuit which electronically switches the trigger signals, and a switching logic circuit which controls the above switching circuits.

The vertical signal switching circuit is, as shown in Figure 27, comprised of a diode gate circuit, an ADD BAL and buffer circuit which switches the vertical signals with the signal received from the switching logic circuit, and a delay line driver which receives the signal from the diode gate and drives the delay line circuit.

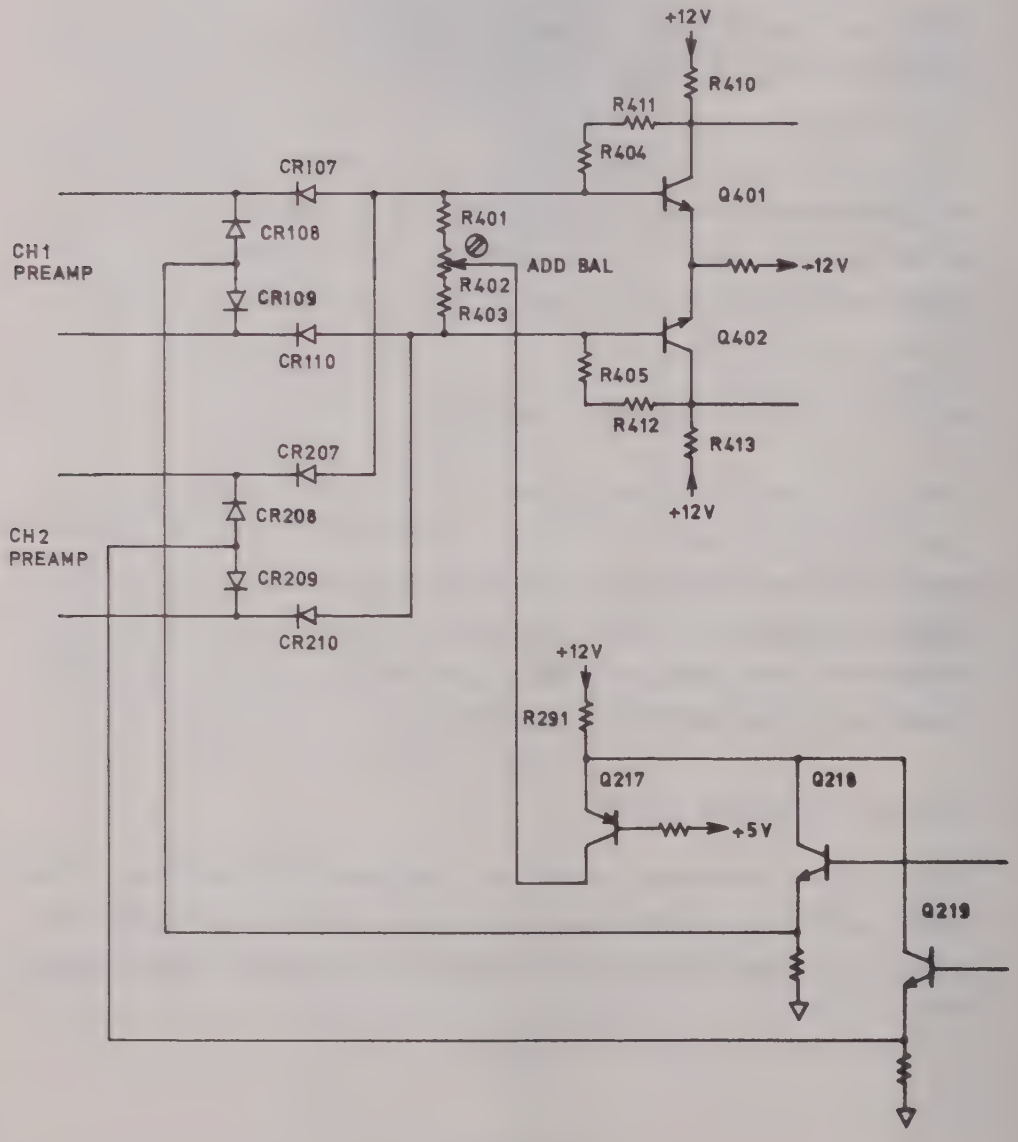


Figure 27

o Diode gate

The diode gate (CR107 - 110/207 - 210) selects the CH1 or CH2 signal or both CH1 and CH2 signals (when in the ADD mode) with the output signal of the switching logic circuit in conformity with the signal selected by the VERT MODE switch (S303).

For example, when the CH1 mode is selected by the VERT MODE switch, the base of Q218 becomes the low state and CR108 and CR109 are cut off. The base of Q219 becomes the high state, a current flows in CR208 and CR209 through R291 from the +12V supply, and CR207 and CR210 are cut off. The current which flows in the negative feedback resistors (R404, 411/405, 412) of the delay line driver circuit is fet to the CH1 preamplifier through CR107 and CR110, and the delay line driver circuit delivers the signal of the CH1 preamplifier.

o ADD BAL circuit:

When the ADD mode is selected by the VERT MODE selector, the bases of Q218 and Q219 become the low state and the signals of the CH1 and CH2 preamplifiers are fed via CR107, 110/CR207, 210 to the delay line driver circuit and the sum of the two signals appears at the output circuit. Disturbance of DC balance which may be caused in this case is compensated for by semi-fixed potentiometer R402 of the DC BAL circuit.

o Delay line driver circuit:

For the delay line driver circuit (Q401, 402), a negative feedback type low input impedance circuit is used from the viewpoint of connecting the diode gate circuit. This circuit has an amplitude limiting function to prevent abnormally large amplitude applied to the vertical output amplifier. By resistors R414 and R415, the impedance of the output circuit is matched with that of the delay line circuit.

o Internal trigger switching circuit:

The internal trigger switching circuit directly controls, with the control signal from the switching logic circuit, the diode gate (CR301 - 304/305 - 308) which is similar to the vertical signal switching circuit. It receives with its grounded-base switching buffer (Q305, 306) the trigger signal which has passed the diode gate circuit and feeds the signal to the balanced/non-balanced amplifier. The balanced/non-balanced amplifier (Q307, 308) converts the balanced output signal of the switching circuit into a non-balanced signal (a single-ended signal) which is delivered as the X-axis signal or the internal trigger signal via connector P-23.

o Vertical switching logic circuit:

The vertical switching logic circuit is comprised of two edged trigger type flip-flops (IC U303) with a preset/clear function, as shown in Figure 28.

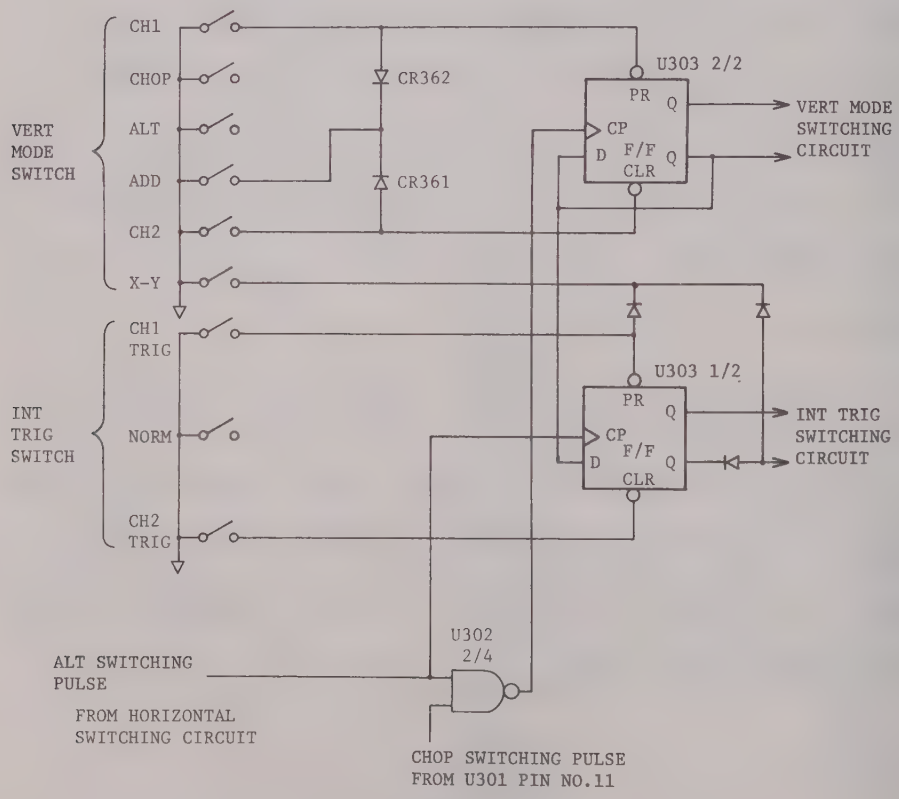


Figure 28

The flip-flop of V303-2/2 controls the vertical signal switching circuit to the mode selected by the VERT MODE switch. The flip-flop of V303-1/2 so controls the internal trigger switching circuit that the trigger signal as selected by the INT TRIG switch is obtained. When the NORM mode is selected by the INT TRIG switch, the output (Q) of the flip-flop of V302-2/2 is fed to the D terminal of the flip-flop of V302-1/2 so that an internal trigger signal conforming with the setting of the VERT MODE switch is obtained. This relationship is shown in the following table:

VERT MODE / INT TRIG MODE	CH1	CH2	CHOP	ALT	ADD	X-Y
CH1	CH1 (▽ provides trigger signal of pre-amplifier.)					-
CH2	CH2 (▽ provides trigger signal of pre-amplifier.)					-
NORM	CH1 (▽)	CH2 (▽)	-	*Alternate outputs	CH1 (▽)	-

* To sweep the CH1 channel when in the ALT mode, the CH1 trigger signal is delivered; to sweep the CH2 channel, the CH2 trigger signal is delivered.

6.4 Delay Line

The output signal of the vertical switching circuit is fed to the delay line (DL501). The delay line is a special type of cable which provides a delay time of approximately 120 nsec. This delay time is required in order to cope with the signal delay which may be caused in the horizontal deflection circuit, Z-axis amplifier, and other circuits and which may make the starting portion of the signal lost from being displayed on the CRT screen. The output signal of the delay line is fed to the vertical output amplifier.

6.5 Vertical Output Amplifier

The vertical output amplifier is comprised of a delay line receiver which receives the output signal of the delay line with a matched impedance, an A & B trace separation circuit which positions the B sweep waveform when in the ALT mode, an emitter follower circuit which converts the output of the delay line receiver into a sufficiently low impedance to drive the final cascade amplifier which drives the vertical deflection plates of the CRT, and an X-Y alignment circuit which adjusts the right-angle feature of the displayed axes. A schematic diagram of the vertical output amplifier is shown in Figure 29.

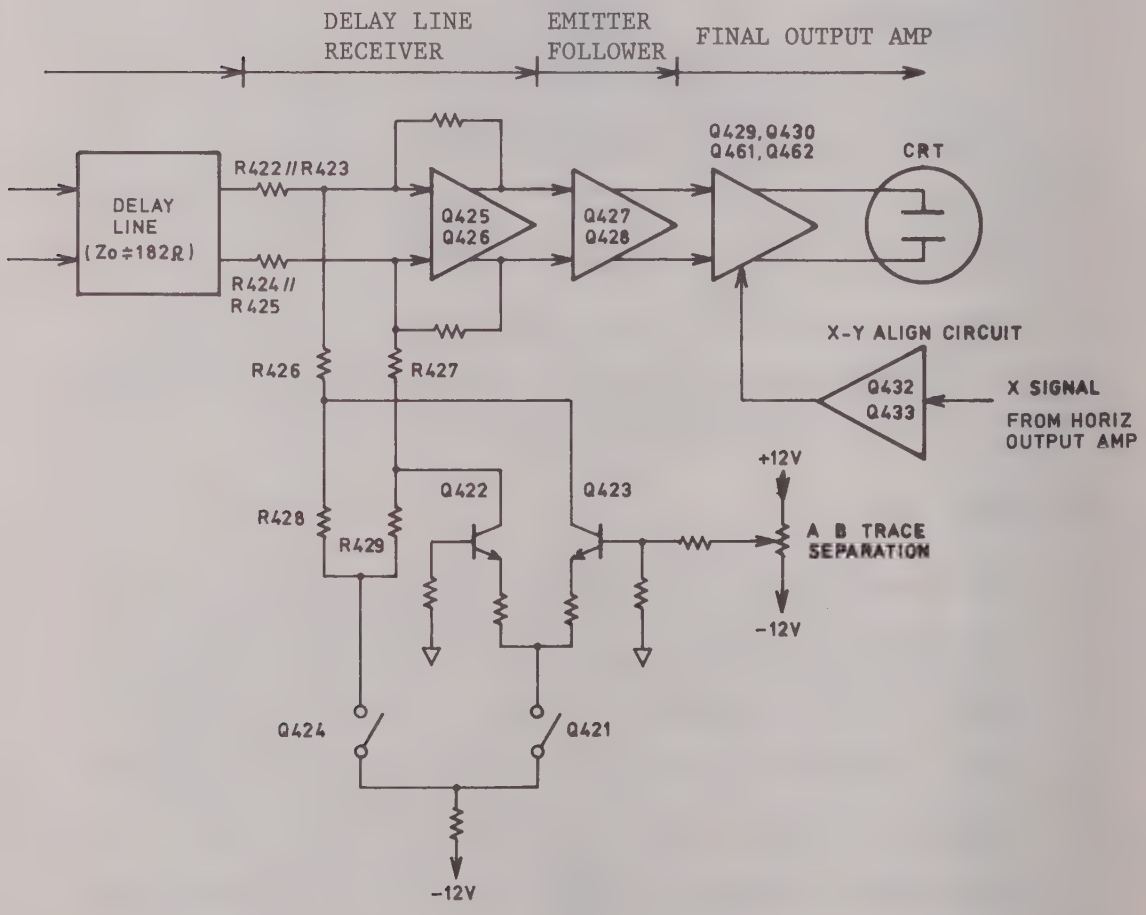


Figure 29

o Delay line receiver circuit:

The delay line receiver circuit (Q425, 426) is a low input impedance negative feedback amplifier which, with its input resistors R422/R423, R424/R425, provides impedance matching with the characteristic impedance (Zo ≒ 182 ohms) of the delay line. With this low input impedance, the A & B trace separation circuit is connected in parallel.

o A & B trace separation circuit:

The A & B trace separation circuit vertically positions the trace by varying the currents which flow through resistors R426 and R427 from the input of the delay line receiver, as shown in Figure 29. In order to prevent intrusion of switching pulses, this circuit has a balanced current circuit (R428 and R429) and an unbalanced current circuit (Q422 and Q423), and these circuits are switched by the transistor switching circuit (Q424, 421). Balancing of the currents which flow in Q422 and Q423 is adjustable with the A & B TRACE SEPARATION potentiometer (R1003).

o Emitter follower:

The emitter follower (Q427, 428) converts the output signal of the delay line receiver into a low impedance to drive the final cascade amplifier. In order to suppress parasitic oscillations, the signal is fed from the emitters of Q427 and Q428 to the bases of Q429 and Q430 through R442 and R445.

o Final cascade amplifier:

The final cascade amplifier is a differential cascade amplifier comprising of a current amplification stage (Q429, 430) which has a high f_T in order to provide a sufficient output voltage to drive the vertical deflection plates of the CRT, and a voltage converter stage (Q481, 482) which employs high-voltage-type high-frequency transistors.

The right-angle compensation current signal of the X-Y alignment circuit is added to the output of the above current amplifier in order to maintain the perpendicularity of the axes on the CRT screen.

o X-Y alignment circuit:

The X-Y alignment circuit (Q432, 433) is a differential amplifier which provides a current signal to compensate for right-angle error of the axes on the CRT screen. This amplifier receives part of the horizontal deflection signal from the horizontal output amplifier and converts it into a perpendicularity compensation current signal, which is applied to the emitters of Q481 and Q482. The polarity and amount of the perpendicularity compensation current signal are adjustable with the X-Y ALIGN potentiometer (R469).

6.6 A and B Trigger Generators

The A trigger generator is comprised of a trigger pulse generator circuit which produces a trigger pulse signal for driving the A (main) sweep generator and an AUTO circuit which produces a free-run signal for automatic sweep operation when the trigger signal is asynchronized or no trigger signal is applied. The B trigger generator produces a trigger pulse for driving the B (delayed) sweep generator when in the B TRIG'D mode.

A Trigger Generator:

As shown in Figure 30, the trigger pulse generator circuit of the A trigger generator is comprised of a source switch which selects a trigger signal source, a coupling switch which selects a coupling mode in conformity with the nature of the trigger signal source, an impedance converter circuit which converts the high-impedance trigger source signal into a low-impedance signal with which to drive the level comparator circuit which controls the start point (triggered point) of the signal waveform displayed on the CRT

screen, a TV synchronization separator circuit which picks off the synchronization signal from the TV video signal, and Schmitt trigger circuits which convert the output signals of the level comparator circuit and TV synchronization signal separator circuit into TTL level signals.

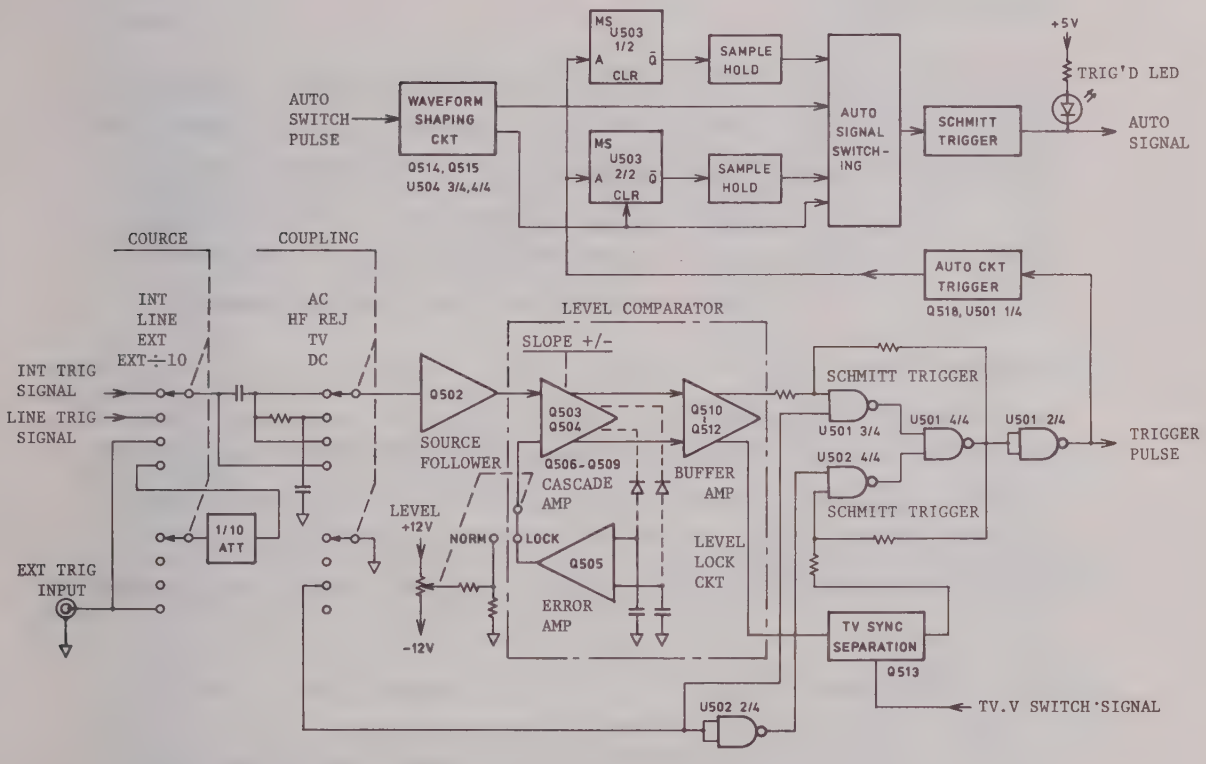


Figure 30

o Source switch:

The source switch (S501) selects the internal trigger signal received by Q501, the external trigger signal fed from J-4, or the signal fed from J-4, which has been attenuated by a factor of 1/10 into the EXT ÷ TRIG signal. The selected signal is fed to the coupling switch.

o Coupling switch:

The coupling switch (S502) selects the coupling mode. Switch S502-1 selects the DC mode for direct coupling of the signal fed from S501, the AC mode for discarding the DC component, or the HF REJ mode for coupling via a low-pass filter. Switch S502-2 selects ON or OFF of the TV synchronization signal separator circuit which facilitates observation of a TV video signal.

o Impedance converter:

The impedance converter is a temperature-compensated-type cathode follower (Q502) with dual FETs. It converts the trigger signal selected by the source switch and coupling switch into a low-impedance signal with which to drive the level comparator circuit.

o Level comparator:

The level comparator is a differential cascade amplifier (Q503, 504, 506 - 509) which adjusts the rise up portion (or the fall down portion) of the comparator output signal, by applying to the base of Q503 of the current amplifier stage the trigger source signal from the impedance converter circuit and adding to the base of Q504 the comparator level signal from the LEVEL control potentiometer (R511). In this case, if switch S503 which is linked to the LEVEL control potentiometer is locked, the comparator level signal is applied to the base of Q504 from the level lock circuit and the trigger point is fixed at the center amplitude of the

trigger source signal. The level lock circuit amplifies with its error amplifier the error signal detected by CR526 and CR527, and feeds back the signal so that the center level of the comparator output signal becomes the Schmitt level of the Schmitt trigger circuit.

The SLOPE switch (S504) selects a slope by switching between Q506, Q509 and Q507, Q508 of the voltage converter stage of the cascade amplifier.

The output signal of the cascade amplifier is amplified further by the feedback-type differential amplifier (Q510, 511, 512) and the amplified signal is fed to the TV synchronization signal separator circuit and the regular (non-TV) Schmitt circuits.

o TV synchronization signal separator circuit:

The TV synchronization signal separator circuit (Q513) is a base leak type circuit and picks off the synchronization signal from a video signal. When in the TV.H synchronization mode, the output signal is directly fed to the Schmitt trigger circuit. When in the TV.H synchronization mode, the circuit produces a TV.V synchronization signal by grounding with V502 3/4 IC the capacitor (C532) which is connected so that the input resistance of the Schmitt trigger circuit becomes the integration resistance of the integration circuit. Switching between TV.V and TV.H is done being linked to the TIME/DIV switch within the following ranges:

TV.V: 0.5 sec - 0.1 msec ranges
TV.H: 50 µsec - 0.1 µsec ranges

o Schmitt trigger circuits:

One of the Schmitt trigger circuits is for the normal mode and is comprised of gate circuits of U501 3/4 and U501 4/4, and the other for the TV mode and is comprised of gate circuits of U502 4/4 and

U501 4/4. Selection between these two circuits is done by turning on the gate circuit of U501 3/4 or that of U502 4/4 with the COUPLING switch (S502-2). The output signal of either Schmitt trigger circuit is inverted by the gate circuit of U501 2/4 and drives the A sweep generator and the AUTO circuit.

o AUTO circuit:

The AUTO circuit converts with its pulse converter (Q518, U501 1/4) the high-speed pulse signal of the trigger pulse generator into the low-speed pulse signal which is applied to the CH1 and CH2 monostable multivibrators (U503 1/2, 2/2) to generate the CH1 and CH2 AUTO signals. With its AUTO switching pulse shaping circuit (Q514, 515, U504 3/4, 4/4), it receives the AUTO switching pulse signal from the vertical switching circuit and generate the CH1 and CH2 AUTO switching pulse signal. This switching signal is applied to the AUTO signal switching circuit (CR534 - 537, Q516, 517) to switch the CH1 and CH2 AUTO signals. The switched AUTO signal is conditioned for waveform-shaping by the Schmitt circuit (V504 1/4, 2/4) to drive the A sweep generator and the TRIG'D LED lamp.

B Trigger Generator

The B trigger generator is identical with the A trigger generator except that the former has no AUTO circuit as no such circuit is required for its operation. It employs a diode gate circuit for trigger source selection. It employs a simpler level lock circuit as it requires AC-coupling only.

6.7 A and B Sweep Generators

The A sweep generator produces the sawtooth signal for the main sweep (A sweep) of this oscilloscope. The B sweep generator produces the sawtooth signal for magnification in the time axis direction the waveform displayed on the main sweep or for display with

a certain time delay (delayed sweep or B sweep).

The A sweep generator consists of the A sweep gate circuit which receives the trigger signal from the A trigger generator and produces the sweep gate signal for starting sweeps, the sweep start comparator which maintains stably the sweep start point, the A sawtooth sweep generator which produces a sawtooth wave in conformity with the time constant selected by the TIME/DIV switch, the sweep length circuit which controls the length of sweeps, the hold off circuit which controls the sweep return period and pause period, and the A sweep gate enable circuit which controls the sweep gate circuit in conformity with the AUTO, NORM or SINGLE mode as selected by the MODE switch for the signals of the above control circuits.

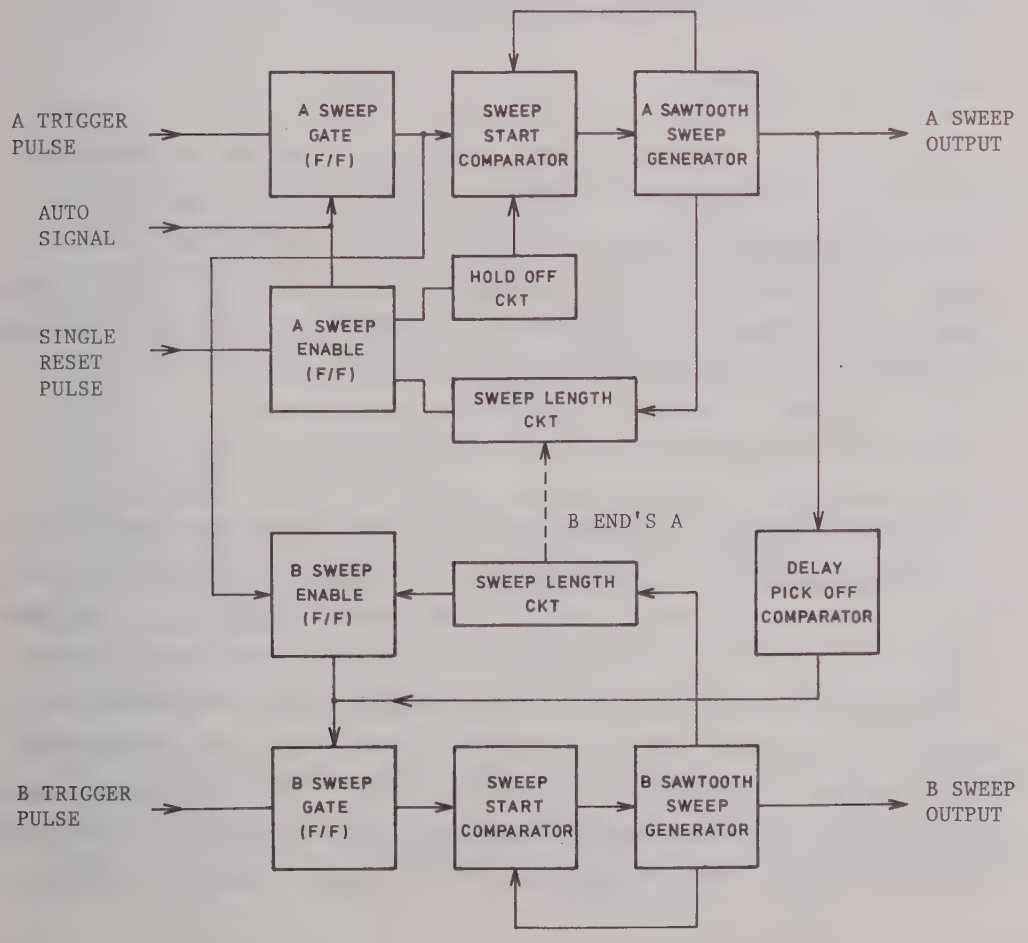


Figure 31

o A sweep gate:

The A sweep gate circuit employs a flip-flop TTL IC (Schottkey type) with RESET/CLEAR function. The trigger pulse of the A trigger generator is applied to the CLOCK (No.1) terminal, the enable signal of the A sweep gate enable circuit to the CLEAR (No.15) terminal, and the enable signal and AUTO signal of the AUTO circuit to the RESET (No.4) terminal through the NAND gate circuit. The Q (No.5) terminal output is applied as the unblanking signal to the Z-axis amplifier and the $\overline{Q}$ (No.6) terminal output is fed to the sweep start comparator circuit and becomes the A sweep gate signal. Even when no trigger pulse signal is applied to the CLOCK terminal, the $\overline{Q}$ output can be made the low state with the AUTO signal of the PRESET terminal so that the A sweep gate signal is generated and the circuit operates in the free-run mode.

o Sweep start comparator:

The sweep start comparator (Q701, 702) is a differential amplifier which lets the sweep gate signal pass and maintains constant the sweep start level. A start reference level identical with the B sweep start level is applied to one of the inputs, the Miller integrator output signal is applied to the other input, and the difference between the two signals is compensated for.

o A sawtooth generator:

The A sweep generator is comprised of a gate transistor amplifier, a Miller integrator, an integration time constant switching circuit, and a logic circuit which controls the switching circuit. The gate transistor amplifier (Q801) controls the Miller integrator circuit in such manner that the start level control signal and sweep gate signal of the sweep start comparator do not affect the integration time constant. The Miller integrator (Q804 - Q806) produces a sawtooth signal with the time constant selected by the integration time constant selector circuit. The integration time constant selector circuit

selects integration capacitor C804/C805 with Q802/Q803 and integration resistors R808 - 816 with CR802 - CR810. The logic circuit selects an integration capacitor and a resistor in conformity with the range selected by the TIME/DIV switch (S801) in order to control the integration time constant selector circuit.

o Sweep length circuit:

The sweep length circuit (Q703, U703 1/4, 2/4, 3/4) divides with its voltage divider (R724, R725, R726) the output of the A sweep generator, converts the impedance with its emitter follower (Q703), shapes the waveform with its Schmitt circuit (U703 1/4, 2/4), and inverts the signal with its inverter (U703 3/4) to produce the length signal. The B END A signal is added to the signal of No.5 pin of U703 2/4.

o Holdoff circuit:

The holdoff circuit generates a holdoff (pause) time signal proportional to the sweep time by producing a triangular wave with the Miller integrator (Q705) and making use of the fall time of the triangular wave. The integrator, with its Q711 and Q712, selects the time constant in accordance with the integration output voltage in order to cover a wide time range. The output signal of the Miller integrator is detected by Q704 and shaped by the Schmitt circuit (U702 1/4, 2/4) into a holdoff signal. The trigger pulse is fed to the input circuit of the Schmitt circuit via R730 and C702 in order to suppress jitter which could be produced when in high speed sweep.

o A sweep gate enable circuit:

The A sweep gate enable circuit employs the flip-flop IC (U701 2/2) which makes up a pair with the A sweep gate circuit. The holdoff signal is applied to the RESET (No.10) terminal, the length signal

is applied to the CLEAR (No.14) terminal, and the enable signal is delivered from the Q (No.9) terminal. This enable signal clears or sets the A sweep gate circuit. When in the NORM sweep mode, the output signal of the AUTO circuit is blocked and, if no trigger signal is applied, the circuit is in the ready state. When in the SINGLE sweep mode, the holdoff circuit remains idle, the J (No.11) terminal is set in the high state, and a one-shot sweep is effected by the reset signal applied from the CLOCK (no.13) terminal.

The basic structure of the B sweep generator is identical with that of the A sweep generator. It consists of the B sweep gate, sweep start comparator, B sawtooth generator, sweep length circuit, B sweep enable circuit, and delay pickoff comparator. The B sweep generator requires no holdoff circuit because it operates only during the period the A sweep generator is in the sweep operation. Instead of the holdoff signal, the A sweep gate signal sets the B sweep enable circuit in the enable state.

o Delay pickoff comparator:

The delay pickoff comparator (Q751 - 754) employs a dual FET (Q751) to obtain a certain time relationship as set by the delay time multiplication potentiometer (R773) with respect to the A sweep signal. The comparator compares the A sweep output signal (sawtooth waveform) with the voltage set by R773, generates a delayed sweep start signal, and sets the B sweep gate circuit to start the B sweep signal. When in the B TRIG'D mode, the B sweep gate circuit is not set directly with this delayed sweep start signal but the J (No.3) terminal is set in the high state and the B sweep signal is started as driven by the trigger pulse of the B trigger generator.

6.8 Horizontal Switching Circuit

The horizontal switching circuit is comprised of a switching buffer circuit which prevents switching distortion from being transmitted to the preceding and succeeding circuits, a horizontal switching circuit which electronically switches the A and B sweep signals and X-axis signal, and a horizontal switching logic circuit which controls the switching circuit.

o Switching buffer circuit:

The switching buffer circuit is of a grounded-base-type amplifier. Transistor Q901 is for buffer-amplification of the A sweep signal, transistor Q902 for the B sweep signal, and transistor Q904 for the X-axis signal.

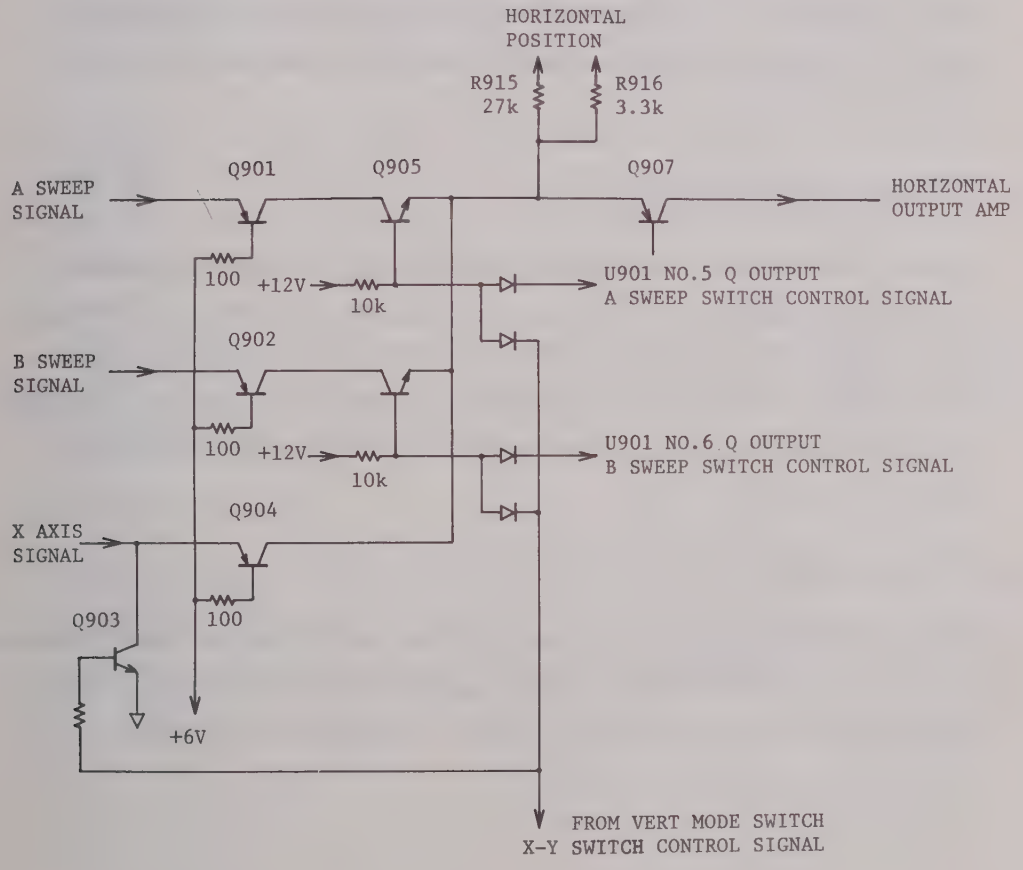


Figure 32

- Horizontal switching circuit:

The horizontal switching circuit, as shown in Figure 32, is a solid-state switching circuit (Q905, 906) which turns on and off the A and B sweep signals by controlling the base voltage. The X-axis signal is turned on and off by controlling with transistor Q703 the emitter of the buffer amplifier (Q904). The switched horizontal signal is superimposed on the horizontal position signal and applied via the buffer amplifier (Q907) to the horizontal output amplifier.

- Horizontal switching logic circuit:

The horizontal switching logic circuit employs a flip-flop TTL IC (U901) with PRESET/CLEAR function. It controls the horizontal switching circuit being dictated by the horizontal display switch. With its U902 IC, it switches the vertical ALT switching pulse signal. U902 3/4 produces a signal for switching the A & B trace separator circuit.

6.9 Horizontal Output Amplifier

The horizontal output amplifier consists of the ×10 MAG circuit which selects gain for the horizontal signal fed from the horizontal switching circuit, the drive amplifier which converts the above signal into a balanced signal and drives the output amplifier, and the output amplifier which drives the horizontal deflection plates of the CRT.

- ×10 MAG circuit:

The ×10 MAG circuit switches the gain by switching the load resistors of the circuit which converts the current mode horizontal signal of the horizontal switching circuit into a voltage mode signal.

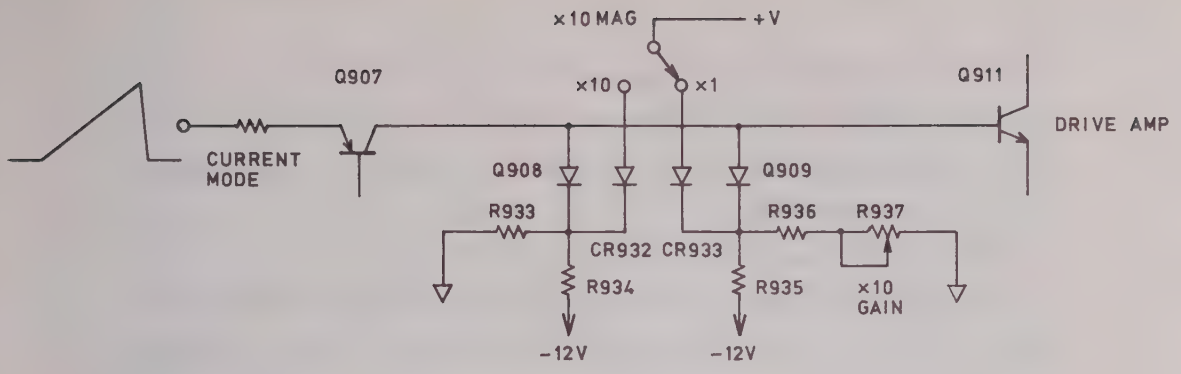


Figure 33

When in the ×1 GAIN mode, diode 909 is in the cut off state as the current flows from the +V supply via CR933. In this case, as CR932 is open, the horizontal signal which is fed through Q907 flows via the diode of Q908 to R933 and is converted into a voltage signal. R934 and R935 are bias resistors.

When in the ×10 MAG mode, the circuit operation is in the reverse of the above. Q908 is cut off, Q909 is on, and the horizontal signal voltage is 10 times of that in the case of the ×1 MAG mode as the resistance is 10 times of R933.

The above voltage-converted signal is fed via the emitter follower (Q910) to the drive circuit and the X-Y alignment circuit of the vertical output amplifier.

o Drive amplifier:

The drive amplifier (Q911, 912) is a differential amplifier. It converts the output of the ×10 circuit into a balanced signal to drive the output amplifier through the diode limiter.

o Output amplifier:

The output amplifier (Q961 - 966) is comprised of feedback-type SRPP amplifiers symmetrical for right and left which provide sufficient speed and output voltage for driving the horizontal deflection plates of the CRT. The signal current-amplified by Q961/Q962 is converted into a voltage signal by Q963/Q964 and at the same time Q965/Q966 is driven as an emitter follower in order to obtain a sufficiently high gain and a sufficiently low output impedance. By means of negative feedback resistor R975/ R976, a stable gain and wide and flat frequency response are attained.

6.10 Z-axis Amplifier

The Z-axis amplifier is comprised of an input circuit and an output amplifier. The input circuit merges the unblanking signals of the A and B sweep generators, the external intensity modulation signal applied through the Z-axis input terminal, the B intensity control signal, and the overall intensity control signal. The output amplifier amplifies the merged signal into a sufficient level for driving the G1 grid of CRT.

o Input circuit:

The input circuit produces the main unblanking signal by merging through the gate circuit (U601 1/4, 2/4) the unblanking signals of the A and B sweep generators and the A intensity gate signal of the horizontal switching circuit. The input circuit also merged to the above merged signal, as selected by the horizontal display switch (S901) and the vertical mode switch (S303), the B intensity control signal, the chopped blanking signal, the external intensity modulation signal applied via the X-axis input terminal, and the overall intensity control signal. The resultant compound signal is fed to the output amplifier.

o Output amplifier:

The output amplifier amplifies the above compound signal to several tens volts. It is of a feedback-type SRPP circuit (Q1011 - 1014) similar to that of the horizontal output amplifier. Transistor Q1011 is for the DC compensation circuit for adjusting the Z-axis input terminal signal to the DC level. The amplified unblanking output signal is applied to the G1 grid of the CRT through the CRT circuit in order to control the trace intensity.

6.11 CRT Control Circuit

The CRT control circuit is comprised of a linear focus circuit which produces a focus voltage proportional to the intensity by converting the unblanking output signal of the Z-axis amplifier, a DC regeneration circuit which converts the focus voltage and unblanking signal into the operating potentials of the CRT in order to be applied to the focus electrode and G1 electrode of the CRT, semi-fixed potentiometers DEFF SHIELD (R1011), ASTIG (R1013), GEOMETRY (R1015) and SUB-FOCUS (R1041), a trace rotation circuit for adjusting the trace direction in parallel with the horizontal graticule lines, and an illumination circuit for illuminating the graticule.

o Linear focus circuit:

The linear focus circuit (Q1016, 1017) inverts and amplifies by approximately 1.5 times the unblanking signal of the Z-axis amplifier. It also merges at its input the focus control signal for fine adjustment of focus.

o DC regeneration circuit:

The DC regeneration circuit converts the linear focus signal and unblanking signal of several tens to several hundreds volts into

AC signals with the switching signal of the DC-DC converter circuit, and then converts them back into DC signals with respects to the cathode voltage and focus reference voltage of the sub-focus potentiometer in order to provide a focus signal and an unblanking signal of the operating voltages of the CRT.

6.12 HV Regulator (High Voltage Generator)

The high voltage generator produces an acceleration voltage (-1500 V) applied to the CRT cathode and a post-acceleration voltage (approximately +8.5 kV) applied to the CRT anode to accelerate the electrons beam which have passed the X and Y deflection plates and mesh electrode. The high voltage generator is a DC-DC converter with a blocking oscillator which generates a high voltage of approximately 1500 Vp-p of a high frequency (approximately 30 kHz) by means of resonance of the secondary coil of a transformer. This high frequency AC voltage is voltage-multiplication-rectified into the +8.5 kV supply and it is double-voltage-rectified into the -1500 V supply. The -1500 V supply is fed through high-resistance feedback resistors (R1052, 1053) to the control circuit (Q1071, 1072) to obtain a stable acceleration voltage. It also is fed through a capacitor-coupling circuit to the DC regeneration circuit in order to be used as the switching signal.

6.13 Power Supply Circuit

The power supply circuit steps up or down with its power transformer the AC line voltage into various voltages and rectifies them to DC supply voltages for the various circuits of the oscilloscope. The primary winding of the power transformer is of a split type, in order that the oscilloscope can be operated on various AC line voltages by connecting the transformer taps in series or parallel as required. Regarding the secondary circuit, the transformer has one 6.3 V winding for the CRT heater and four windings

of different voltages for different circuits of the CRT. The AC voltages of these four windings are rectifies and supplied as regulated +230 V, +170 V and +21 V powers and non-regulated +90 V, +40 V, +12 V, +5 V and -12 V powers.

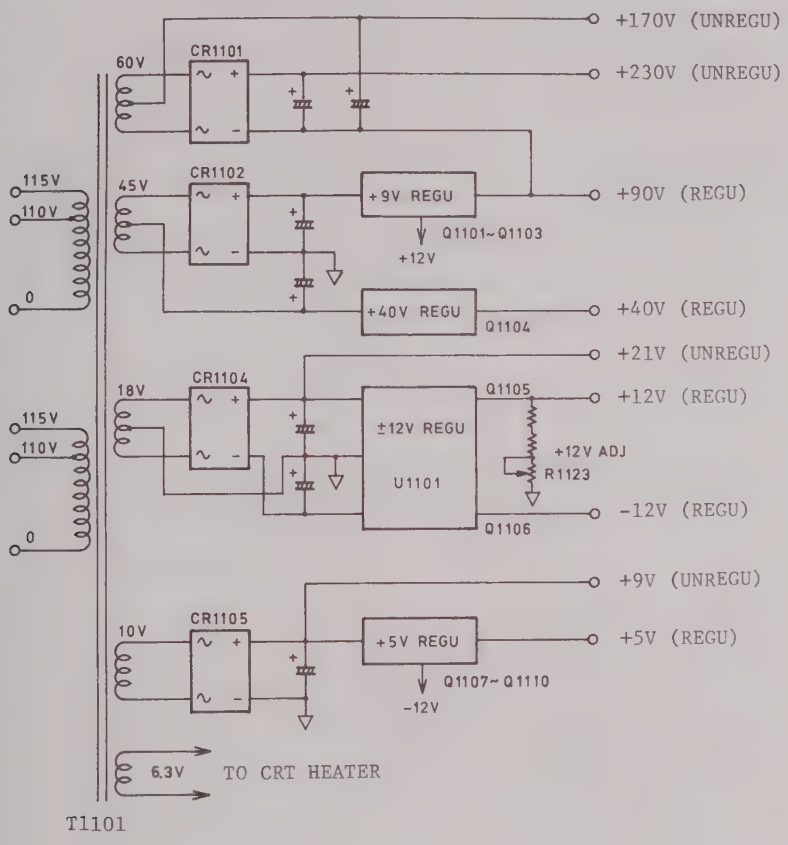


Figure 34

6.14 Calibrator Circuit

The calibrator circuit provides square-wave calibration voltage signals of 2 Vp-p and 200 mVp-p which are used for calibration of the probe and the amplifiers when they are operated in the non-calibrated mode. The voltage accuracy of the calibration signals is 2% or better. The calibration signals are produced by generating a signal with the multibrator of CMOS IC (U1102 1/4, 2/4), shaping the waveform with the Schmitt circuit of CMOS IC (U1102 3/4, 4/4), and dividing the voltage signal with resistors.

7.1 General

After the oscilloscope has been used for a period of time, it should be calibrated. Although calibration of overall performances is recommended, partial calibration may serve the purpose that the time axis alone is calibrated when the time measuring accuracy is especially important or that the vertical axis alone is calibrated when the vertical sensitivity accuracy is of prime importance. After the oscilloscope has been repaired, overall calibration is suggested although it depends on the type of repair. For accurate calibration service, contact Kikusui's representative in your area.

7.2 Removing the Case

To remove the case, remove the six screws (Figure 35) and pull out the chassis forward. To remove the rear cover, remove the four screws shown in Figure 36.

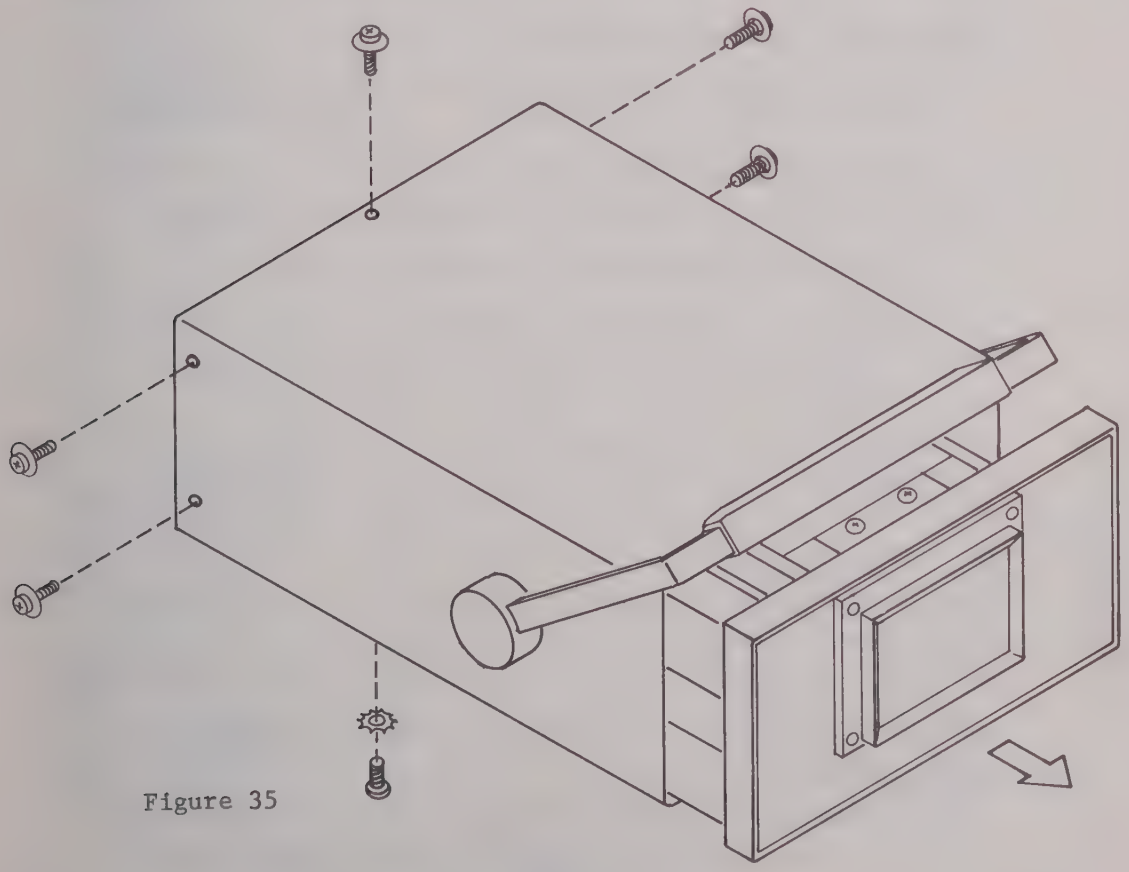


Figure 35

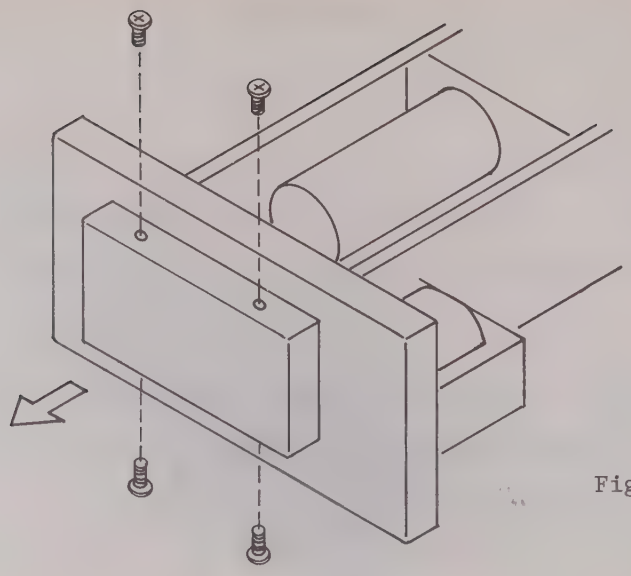


Figure 36

7.3 Check and Adjustment of DC Supply Voltages

Before calibrating the oscilloscope, its DC supply voltages should be checked and adjusted. Check and adjust the +12V supply voltage first and the other supply voltages next. The supply voltages shown in the following table and the check and adjustment points are indicated in Figures 42 and 43.

Nominal voltage	Voltage range	Check and adjustment points
+ 5 V	+4.75 - 5.25 V	TP-2
+12 V	+11.95 - 12.05 V	TP-3 R1123
-12 V	-11.80 - 12.20 V	TP-1
+40 V	+42 - 48 V	TP-4
+90 V	+92 - 98 V	TP-7
+170 V	+165 - 185 V	TP-6
+230 V	+235 - 265 V	TP-5
-1500 V	-1490 - 1510 V	TP-8 R1056

For voltage check, measure the voltage between check point and ground using precision digital voltmeter. The +12V supply must be especially carefully adjusted because it provides a reference for other supplies. To measure the -1500V supply of which internal impedance is high, use a voltmeter of a high input impedance (10 MΩ or over).

Because adjustments of supply voltages largely affects vertical sensitivity and horizontal sweep time, the oscilloscope must be re-calibrated as explained in the subsequent paragraphs.

7.4 Adjustment of CRT Circuits

Some adjustments of the CRT circuits directly affect the CRT deflection sensitivity as is the case of "Check and Adjustment of DC Supply Voltages" of the preceding section. After the GEOMETRY, DEFLECTION SHIELD and HORIZ LIMIT are adjusted, the vertical sensitivity and sweep time must be calibrated.

- o Adjustment of SUB INTEN:

  This control is for adjusting the operating position of the INTEN knob (23) .

  (1) Set the TIME/DIV switch (45) at 1 mS and display the single-line horizontal trace on the screen.

  (2) Set the white mark of the INTEN knob in the upright position (noon position) and so adjust the SUB INTEN control (Figure 43, R1017) that the trace is displayed on the screen with a barely discernible intensity.

- o Adjustment of GEOMETRY:

  This control is for reducing geometrical distortions.(pincushion distortions or barrel distortions) of the pattern displayed on the screen.

  (1) Apply a sinusoidal signal of approximately 50 kHz to vertical input terminal (9) or (15) and display the signal with an amplitude of 8 DIV and with approximately 50 peaks.

  (2) So adjust the GEOMETRY control (Figure 43, R1015) that the displayed pattern becomes as (b) in Figure 37.

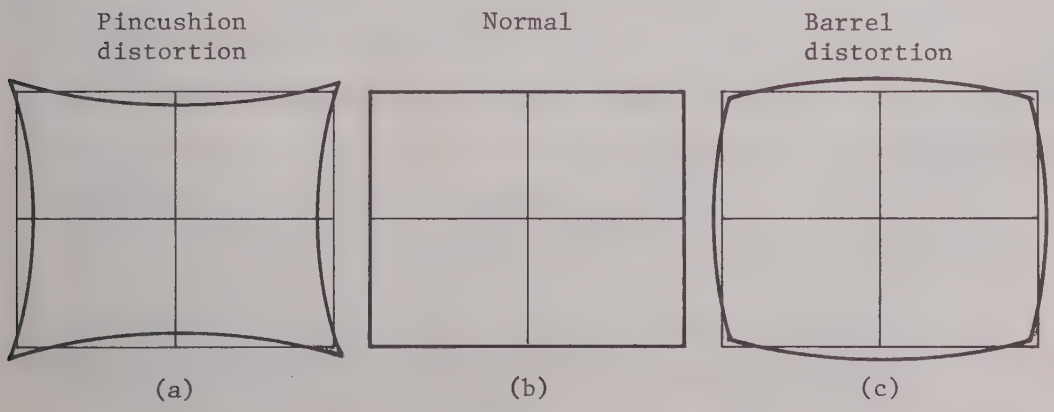


Figure 37

o Adjustment of DEFLECTION SHIELD:

This control is used to reduce halation on the screen for improving the contrast and to improve the linearity of the displayed waveform.
So adjust the DEFLECTION SHIELD control (Figure 43, R1011) that the best focus is obtained with the ASTIG voltage set at +70 to +80 volts.

o Adjustment of SUB-FOCUS:

This control is for adjusting the control range position of the FOCUS knob (25) . With the FOCUS knob set with its white dot positioned upright (noon position), so adjust the SUB-FOCUS control (Figure 43, R1041) that the best focus is obtained.

o Adjustment of HORIZ LIMIT:

This control is used to suppress halation (caused by the electron beam reflected and scattered in the cathode-ray tube) resulting from change in the horizontal POSITION adjustment and 10 × MAG operation.

(1) Apply the CALIB signal (28) and (29) to the vertical input terminals and display waveforms of an amplitude of 4 DIV and 10 peaks.

(2) Turn ON (▂) the 10 × MAG switch (39) . Turn the HORIZ LIMIT control (Figure 44, R961) from the extremely counter-clockwise position gradually to clockwise position and stop at the position where halation on the screen is reduced. This is the normal position for the HORIZ LIMIT control. (If you turn the control excessively clockwise, the displayed waveform may away to right and left when the LINE voltage is lower by approximately -10% than the nominal voltage.)

o Adjustment of Y AXIS ALIGN:

This control is for adjustment of the perpendicularity (90°) between horizontal trace (sweep) and vertical trace.

(1) Ground CH1. Apply to CH2 the output of a sine wave signal generator and display the signal with an amplitude of 8 DIV on the screen.

(2) Set the VERT MODE switch (1) in the X-Y mode and so adjust the TRACE ROTATION control (26) that the vertical trace becomes parallel with the graticule scale.

(3) Next, change the VERT MODE switch to CH1 and so adjust the Y AXIS ALIGN (Figure 45, R468) that the horizontal trace becomes parallel with the horizontal scale of the graticule.

By the above procedure, the horizontal trace and vertical trace are adjusted mutually perpendicular.

7.5 Adjustment of Vertical Axis

o Adjustment of DC BAL:

This control is for minimizing the shift of the trace when the VARIABLE knob (6) or (14) is turned.

(1) Set the AC-GND-DC switch (8) or (16) in the GND state and display the trace on the CRT screen.

(2) Turning the VARIABLE knob, so adjust the DC BAL control that the shift of the trace becomes minimum. (Figure 45, R131 and R231).

o Adjustment of 5 × MAG BAL:

This control is for minimizing the shift of trace when the 5 × MAG switch (4) or (17) is changed.

(1) Set the AC-GND-DC switch (8) or (16) in the GND state and display the trace on the screen.

(2) Turning ON (▂) and OFF (▉) the 5 × MAG switch, so adjust the 5 × BAL (Figure 45, R164 or R264) that the shift of trace becomes minimum.

o Sensitivity Calibration:

Calibrate the sensitivity of the vertical amplifier to the value indicated by the VOLTS/DIV switch (5) or (13). For this adjustment, use a square wave generator with an output voltage setting accuracy of 0.3% or better at 1 kHz.

(1) Set the signal generator output at 40 mVp-p and apply the signal to the vertical input terminal (9) or (15).

(2) Set the VARIABLE knob (6) or (14) at the CAL'D position and set the VOLTS/DIV switch at the 5 mV range.

(3) So adjust the 5 mV GAIN control (Figure 45, R141 or R241) that the amplitude of the displayed waveform becomes 8 DIV.

(4) Next, set the generator output at 8 mV and turn ON (▬) the 5 × MAG switch (4) or (17).

(5) So adjust the 5 × GAIN control (Figure 45, R167 or R267) that the amplitude of the displayed waveform becomes 8 DIV.

By the above procedure, other ranges also are calibrated to an accuracy of ±3% or better.

o Adjustment or INV BAL:

This control is for minimizing the shift of trace when the CH2 POLARITY switch is changed.

(1) Set the AC-GND-DC switch (16) in the GND state and display the trace on the screen.

(2) Turning ON (▬) and OFF (▙) the CH2 POLARITY switch, so adjust the INV BAL control (Figure 45, R295) that the shift of trace becomes minimum.

o Adjustment of ADD BAL:

With both CH1 and CH2 channels operating in the single-line horizontal trace mode, so adjust this control that the traces do not shift when the VERT MODE switch is changed to the ADD mode.

(1) Set the AC-GND-DC switches (8) and (16) in the GND state and display the traces of the two channels overlapped in the center of the screen.

(2) Change the VERT MODE switch to the ADD state and so adjust the ADD BAL control (Figure 45, R402) that the trace are positioned in the center of the screen.

o Adjustment of square wave characteristics of vertical amplifiers:

This adjustment should be done to adjust the square wave characteristics of the vertical amplifiers so that their frequency response becomes flat. The adjustment should be done at a range

which dose not use the input attenuator (5 mV/DIV range), using two or more square waves of different frequencies.

The adjustment should be done using a quality square wave with rise time 3.5 nsec or faster, and should be done in the order of low, middle, higher middle, and high ranges, repeating adjustment in this order of different frequencies for a few times.

(1) Adjustment for low frequency range:

Set the VOLTS/DIV switch at 5 mV/DIV and the TIME/DIV switch at 2 mS/DIV. Apply to the vertical input terminal a square wave of 100 Hz and so adjust the signal generator output that the waveform with an amplitude of 6 DIV is displayed.

Next, so adjust R446 (Figure 45) that the displayed waveform becomes as (b) in Figure 38.

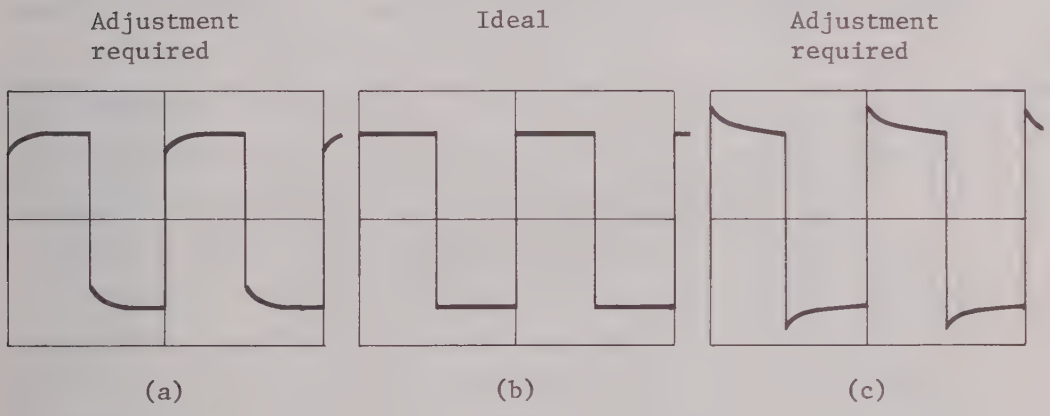


Figure 38

(2) Adjustment for middle frequency range:

Change the input pulse signal frequency to 20 kHz and set the TIME/DIV switch at 10 μS/DIV. Next, so adjust R409 and C404 (Figure 45) that a square wave as shown in (d) of Figure 39 is displayed. For this adjustment, set R409 at an appropriate position and then adjust C404 so that a waveform as close to that of (d) as possible is obtained. Repeat this procedure for a few times so that a waveform as shown in (d) is obtained.

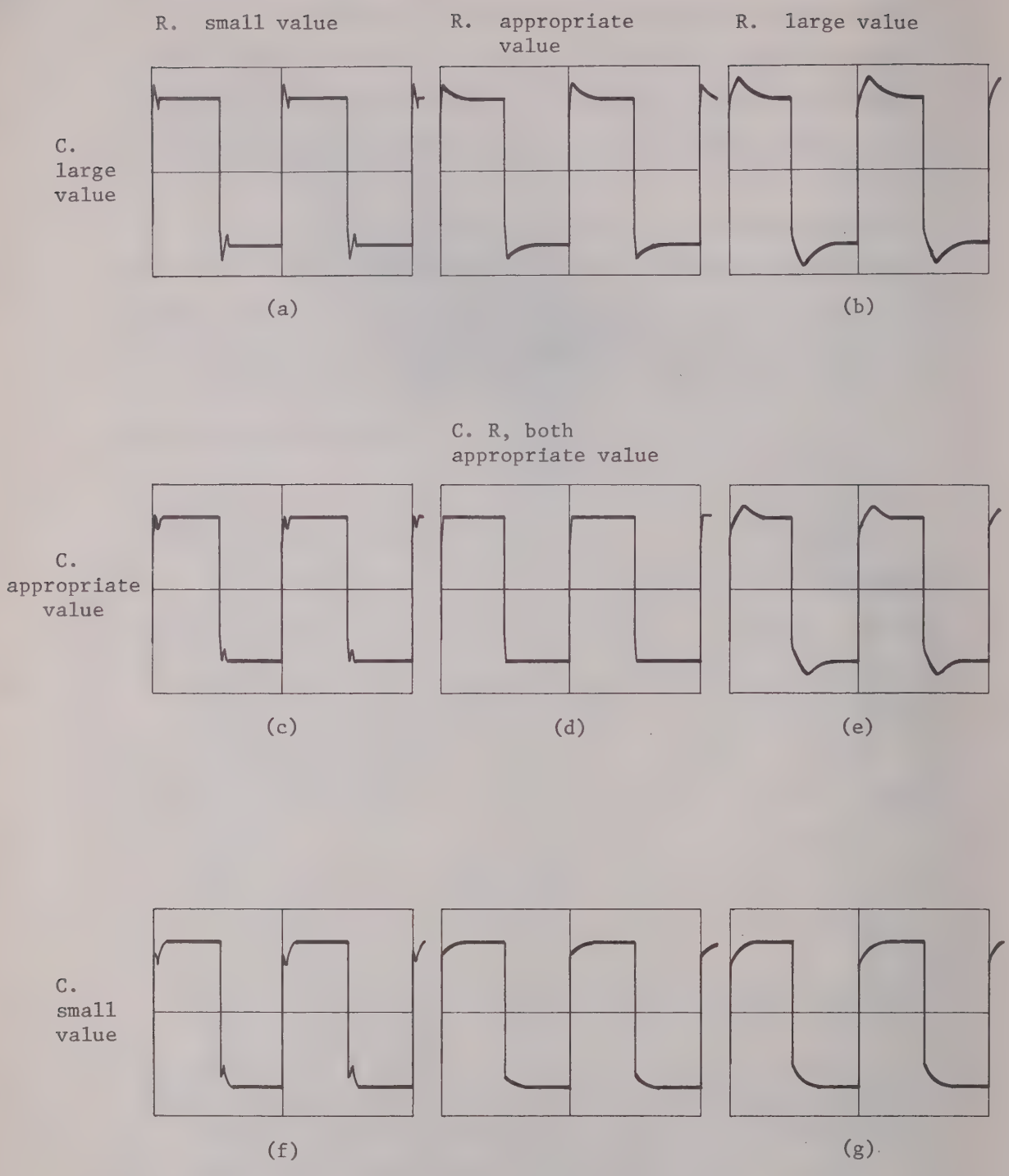

R. small value
R. appropriate value
R. large value
C. large value
(a)
(b)
C. R, both appropriate value
C. appropriate value
(c)
(d)
(e)
C. small value
(f)
(g)

Figure 39

(3) Adjustment for higher middle frequency range:

Change the input square wave signal to 200 kHz and set the TIME/DIV switch at 1 μS/DIV. Next, in a similar manner as the case for "adjustment for middle frequency range," so adjust R178 and C143 for CH1 or R278 and C243 for CH2 that a waveform as shown in (d) of Figure 39 is displayed.

(4) Adjustment for high frequency range:

Change the input square wave signal to 1 MHz and set the TIME/DIV switch at 0.2 μS/DIV. Next, in a similar manner as the case for "adjustment for middle frequency range," so adjust R408 and C403 or R447 and C429 that a waveform as shown in (d) of Figure 39 is obtained.

Next, adjust the amplitude of the pulse signal to 4 DIV and so adjust R448, C430 and C133 or C233 that the front edge of the square wave becomes flat.

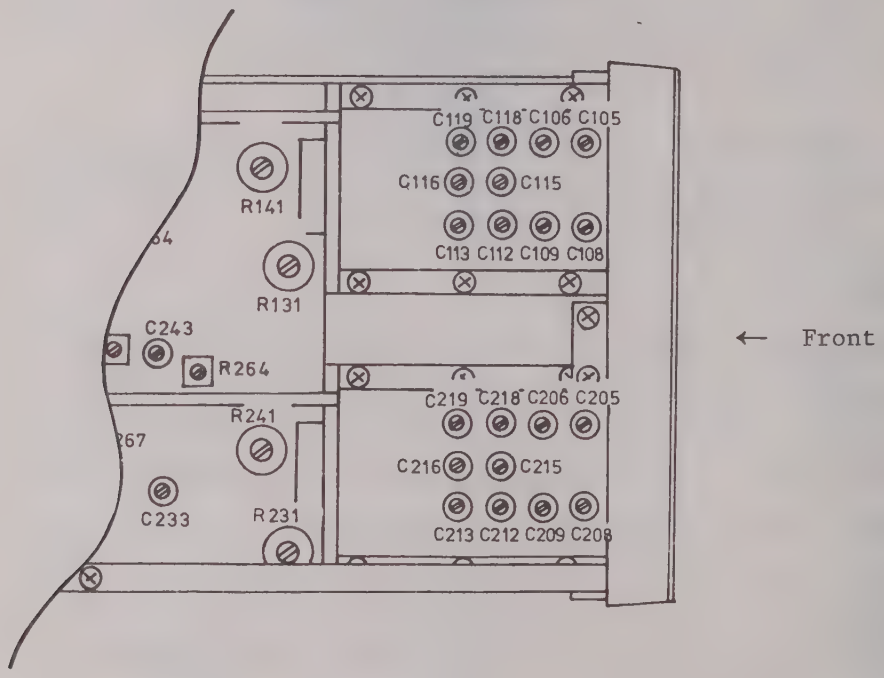
o Adjustment of input ATT:

The VOLTS/DIV switch selects the oscilloscope sensitivity by switching the attenuator circuit consisting of pre-stage attenuator (1/10-steps) and post-stage attenuator (1/2, 1/4, 1/10-steps). This procedure is for phase compensation and input capacitance adjustment of the attenuators. Adjustments should be done in the order of phase compensation and input capacitance adjustment for the post-stage attenuator and then phase compensation and input capacitance adjustment of the pre-stage attenuator.

(1) Adjustment of post-stage attenuator:

Use a square wave signal generator which provides a quality square wave of rise time 1 μsec or faster, without sags or overshoots. Apply the signal for each of the ranges (10 mV, 20 mV, 50 mV) and display a waveform with an amplitude of 6 DIV. So adjust the phase compensation capacitor shown in the following table that an ideal waveform is displayed. Next, connect a low-capacitance C-meter to the input terminal and so adjust the input-capacitance compensation capacitor that the input capacitance at each range becomes 20 pF $\pm$2 pF.

Compensation capacitor / Range	CH1		CH2	
	Phase compen-sation	Input capacitor	Phase compen-sation	Input capacitor
10 mV (1/2)	C113	C112	C213	C212
20 mV (1/4)	C116	C115	C216	C215
50 mV (1/10)	C119	C118	C219	C218



(Left hand side view)

(2) Adjustment of post-stage attenuator:

In a similar manner as (1) above, adjust the phase compensation capacitor and input-capacitance compensation capacitors shown in the following table for each of the ranges (5 mV, 0.1 V, 1 V).

Compensation capacitor / Range	CH1		CH2	
	Phase compen-sation	Input capacitor	Phase compen-sation	Input capacitor
5 mV (1/1)	-	-	-	-
0.1 V (1/10)	C106	C105	C206	C205
1 V (1/100)	C109	C108	C209	C208

When the above adjustment is done, all other ranges also are automatically adjusted.

7.6 Adjustment of Trigger Circuits

o Adjustment of TRIG. LOCK:

This adjustment is for making optimum the TRIG.LOCK sensitivity of the trigger circuit of the A sweep.

(1) Apply a sinusoidal wave of approximately 1 kHz to the vertical input terminal and display a waveform with an amplitude of approximately 8 DIV on the screen.

(2) Turn the LEVEL knob (33) to the extremely ~~clockwise~~ CCW position (LOCK position).

(3) Turning ON (▂) and OFF (▉) the SLOPE push button, so adjust R539 and R555 (Figure 42) that the start point of the waveform becomes the center of the displayed waveform amplitude.

(4) Next, apply a sinusoidal wave of approximately 35 MHz to the vertical input terminal and so adjust the signal generator output that the signal is displayed with an amplitude of 0.5 DIV on the screen.

(5) Under the above state, finely re-adjust R539 and R555 that the triggering does not fail when the SLOPE pushbutton is turned ON (▂) and OFF (▉).

o Adjustment of TRIG LOCK of B sweep:

This adjustment is for making optimum the TRIG LOCK sensitivity of the trigger circuit of the B sweep. Adjust R618 and R634

(Figure 42) in a similar manner as in the case of "Adjustment of TRIG LOCK."

o Adjustment of TRIG DC OFFSET (for trigger circuit of A sweep only):

This adjustment is for attaining such state that, when the trigger signal is AC-coupled and the white dot of the LEVEL knob is set in the upright position (noon position), the trigger point is at the center of the displayed waveform amplitude.

(1) Apply a sinusoidal wave of approximately 1 kHz to the vertical input terminal and display the signal waveform with an amplitude of approximately 8 DIV on the screen.

(2) So set the LEVEL knob that its white dot is positioned at the noon position. So adjust R533 (Figure 42) that the trigger point (trace start point) is positioned at the center of the displayed waveform amplitude.

o Adjustment of CH1 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH1 internal trigger output.

(1) Apply a sinusoidal signal of approximately 1 kHz to the CH1 input terminal and set the AC-GND-DC switch at AC.

(2) Set the VERT MODE switch at CH1, set the INT TRIG switch at CH1 or NORM, and display the signal with an amplitude of 8 DIV on the screen.

(3) Set the COUPLING switch at AC and so adjust the LEVEL knob that the trigger point is brought to the center of the displayed waveform amplitude.

(4) Change the COUPLING switch to DC and so adjust the CH1 TRIG DC OFFSET (Figure 45, R307) that the trigger point is brought to the center of the dispalayed waveform amplitude.

* This adjustment affects the X-Y positions. Be sure to adjust the X-Y POSITION ADJ after this adjustment has been done.

o Adjustment of CH2 TRIG DC OFFSET:

This adjustment is for offsetting to zero the DC-component displacement of the CH2 internal trigger output.

For this adjustment, adjust CH2 TRIG DC OFFSET (Figure 45, R316) in a similar manner as is the case for "Adjustment of CH1 TRIG DC OFFSET."

7.7 Adjustment of Time Base

o Calibration of A sweep time:

This adjustment is for calibrating the sweep time to the values indicated by the TIME/DIV switch. For this adjustment, use time marker signals of accurate time intervals of 1 msec and 1 sec or use signals of accurate frequencies of 1 kHz and 100 kHz.

(1) Apply to the vertical input terminal a time marker signal of 1 msec or a signal of 1 kHz, and deflect the signal with an appropriate amplitude on the screen.

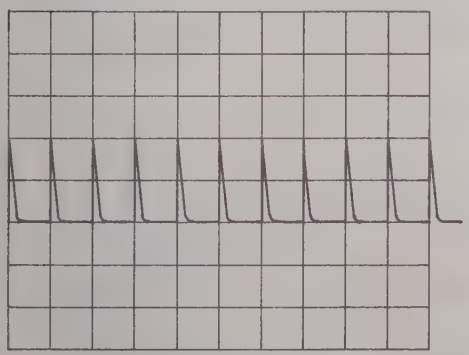
(2) Set the VARIABLE knob (44) in the CAL'D position. Set the TIME/DIV switch (45) at 1 mS.

(3) So adjust the A SWEEP CAL (Figure 46, R822) that the displayed waveform conforms with scale divisions of the graticule.

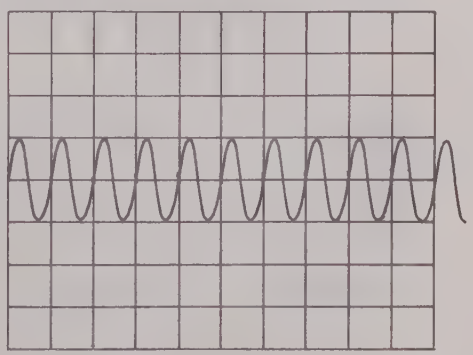
(4) Change the input signal to a time marker signal of 10 μS or sinusoidal wave signal of 100 kHz and change the TIME/DIV switch (45) to 10 μS.

(5) So adjust the A 10 μS CAL (Figure 46, C802) that the displayed signal waveform conforms with scale divisions of the graticule.

When the above calibration is complete, the sweep speeds of the remaining ranges also are calibrated at an accuracy of $\pm$3%.



Time marker signal



Sinusoidal wave signal

Figure 40

o Calibration of B sweep time:

Calibrate the sweep time to the indicated values of the TIME/DIV switch (46). Adjust the B SWEEP CAL (Figure 46, R871) and B 10 μS CAL (Figure 46, C852) in a similar manner as that for the case of "Calibration of A sweep time."

o Adjustment of LENGTH:

This adjustment is for setting the lengths of the A and B sweeps at 11 DIV. Set the TIME/DIV switches (45) and (46) at 1 mS and apply a time marker signal of 1 msec or a signal of repetition frequency 1 kHz, and so adjust the A SWEEP LENGTH (Figure 42, R725) and B SWEEP LENGTH (Figure 42, R735) that the sweep lengths become 11 DIV.

o Adjustment of sweep start point:

This adjustment is for attaining such state that, when the horizontal POSITION knobs (47) and (48) are set with their white dots in the noon positions, their sweeps start at the left hand end of the graticule.

(1) Set the TIME/DIV switches (45) and (46) at 1 mS, set the HORIZ DISPLAY switch (50) at ALT, and display both A and B sweeps on the screen.

(2) So set the horizontal POSITION knobs (47) and (48) that their white dots are positioned upward (noon position). So adjust the A SWEEP POSITION (Figure 46, R902) that the start point of the A sweep is brought to the left hand end of the graticule.

(3) Next, with the B SWEEP POSITION (Figure 46, R906), bring the start point of the B trace to the left hand end of the graticule.

o Adjustment of 10 × MAG DC BAL:

This adjustment is for attaining such a state that, when the 10 × MAG switch (39) is turned ON (▂), the displayed waveform is magnified to right and left from the center of the screen.

(1) Set the TIME/DIV switch (45) at 1 mS. So adjust the horizontal POSITION knob that the start point of the sweep is brought to the center of the screen.

(2) Turn ON (▬) the 10 × MAG switch. So adjust the 10 × BAL (Figure 46, R939) that the start point of the sweep is brought to the center of the graticule.

o Adjustment of 10 × MAG:

This adjustment is for calibration of the sweep time when the 10 × MAG switch (39) is turned ON (▬). Before performing this adjustment, make sure that the adjustment for "Calibration of the A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 0.1 mS or a signal of 10 kHz and display the signal with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (44) in the CAL'D position and the TIME/DIV switch (45) at 1 mS.

(3) Turn ON (▬) the 10 × MAG switch and so adjust the 10 × CAL (Figure 46, R937) that the displayed waveform conforms with scale divisions of the graticule.

o Calibration of DELAY TIME MULTI:

This calibration is for calibrating the dail value of the DELAY TIME MULTI to the sweep time. Before performing this calibration, make sure that the adjustment for "Calibration for A sweep time" has been done.

(1) Apply to the vertical input terminal a time marker signal of 1 mS and display the waveform with an appropriate amplitude on the screen.

(2) Set the VARIABLE knob (44) in the CAL'D position, set the TIME/DIV switch (45) at 1 mS, set the TIME/DIV switch (46) at 10 μS, and change the HORIZ DISPLAY switch (50) to the A INTEN state.

(3) Set the dial indication of the DELAY TIME MULTI at 1.00 and align the displayed waveform with graticule.

(4) So adjust the B START LEVEL (Figure 46, R764) that the accentuated portion of the waveform is aligned to the initial pulse as shown in Figure 41.

(5) Set the dial indication of the DELAY TIME MULTI at 10.00.

(6) So adjust the B END LEVEL (Figure 46, R769) that the accentuated portion of the waveform is aligned to the 10th pulse.

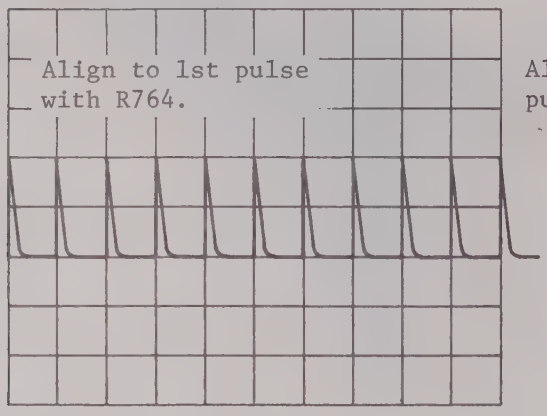


Figure 41

7.8 Adjustment of Horizontal Axis (X-axis)

o Calibration of horizontal sensitivity:

This adjustment is for calibration of the X-axis sensitivity for X-Y operation.

(1) Set at 50 mVp-p the output of the signal generator used for "Calibration of sensitivity" of section 7.5, and apply the output to the CH1 (X-axis) input.

(2) Set the VERT MODE switch (1) in the X-Y state. Set the AC-GND-DC switch (15) of CH2 (Y-axis) at GND.

(3) Set the VARIABLE knob (6) at CAL'D and the VOLTS/DIV switch (5) at 5 mV.

(4) So adjust the X-GAIN (Figure 45, R304) that the trace length becomes 10 DIV.

* This adjustment affects CH1 TRIG DC OFFSET adjustment and X-Y POSITION adjustment. Be sure to repeat these adjustments after the horizontal axis sensitivity adjustment is done.

o Adjustment of X-Y POSITION:

This adjustment is to obtain such a state that the spot is positioned in the center of the screen when the horizontal POSITION knobs (47) and (48) are set with their white dot positioned upward (noon position) in the X-Y operation.

(1) Operate the oscilloscope in the X-Y mode and set both inputs in the GND state.

(2) Set the horizontal POSITION knobs (47) and (48) with their white dot positioned upward (noon position) and so adjust the X-Y POSITION (Figure 46, R909) that the spot is positioned in the center of the screen.

7.9 Adjustment of Calibration Voltage

o Adjustment of repetition frequency:

(1) Connect the CALIB output (28) or (29) to a frequency counter.

(2) So adjust the CALIB FREQ (Figure 42, R1152) that the frequency counter reads 1 kHz.

o Calibration of the output voltage:

This adjustment is for calibrating the output voltage of the calibration signal in a substitution method.

(1) Set at 200 mVp-p the signal of the generator used for "calibration of sensitivity" of Section 7.5. Apply this signal to the CH1 input terminal.

(2) Display the signal on the screen with an amplitude of 8 DIV by adjusting the VOLTS/DIV switch (5) and VARIABLE knob (6).

(3) Apply the 200 mV CALIB output (28) to the CH1 input terminal. So adjust the CAL OUT (Figure 42, R1160) that the signal is displayed with an smplitude of 8 DIV on the screen in the same manner as step (2) above.

This completes the CAL voltage ADJ procedure.

R533	TRIG LEVEL CENTER
R539	TRIG LOCK BAL (A SWEEP)
R555	TRIG SENS (A SWEEP)
R618	TRIG LOCK BAL (B SWEEP)
R634	TRIG SENS (B SWEEP)
R725	A SWEEP LENGTH
R735	B SWEEP LENGTH
R1123	+12V ADJ
R1152	CALIB FREQ
R1160	CALIB OUTPUT LEVEL

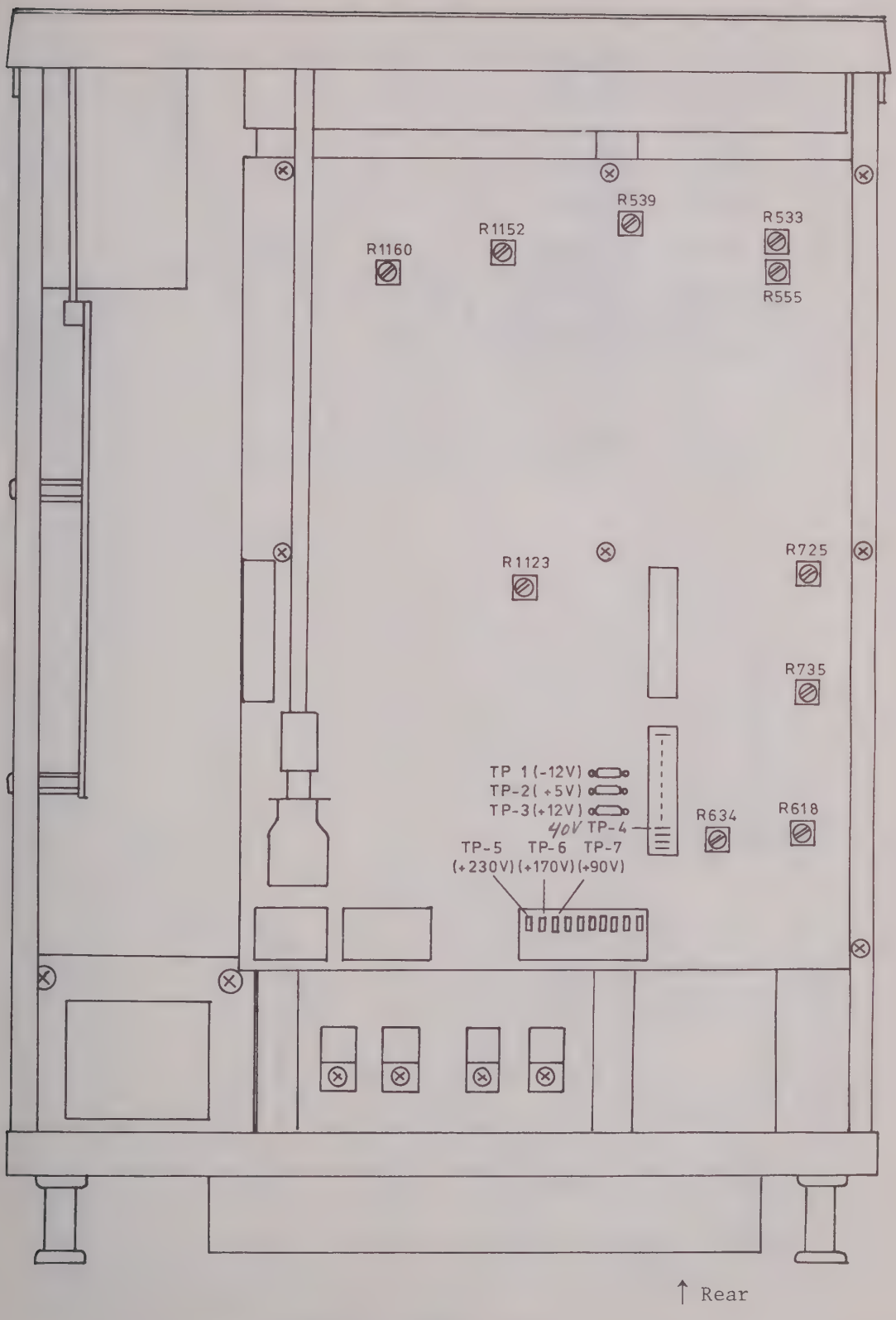


Figure 42 (Bottom view)

R1011	DEFF SHILD
R1013	ASTIG
R1015	GEOMETRY
R1017	SUB INTEN
R1041	SUB FOCUS
R1056	HV ADJ (-1500V)
TP-8	-1500V
R961	HORIZ LIMIT

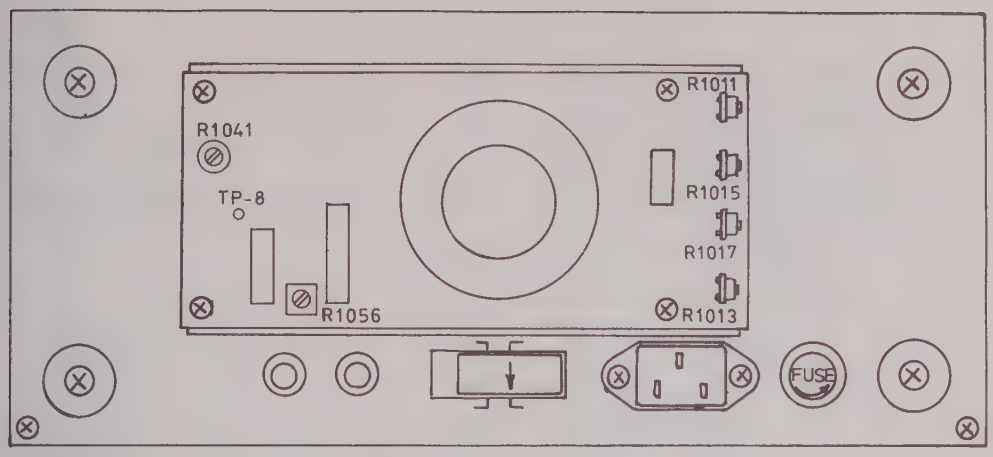


Figure 43 (Rear view)

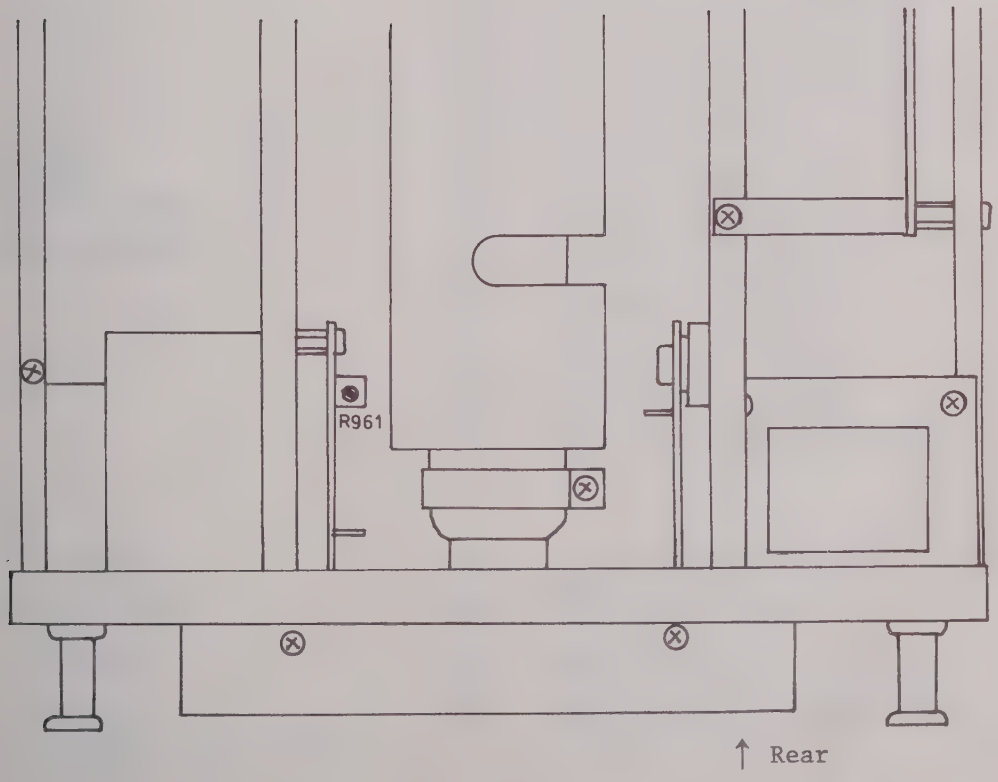


Figure 44 (Top view)

R131	CH1 DC BAL
R141	CH1 5mV GAIN
R164	CH1 5 × MAG BAL
R167	CH1 5 × MAG GAIN
R178	CH1 higher middle freq range
R231	CH2 DC BAL
R241	CH2 5mV GAIN
R264	CH2 5 × MAG BAL
R267	CH2 5 × MAG GAIN
R278	CH2 higher middle freq range
R295	CH2 INV BAL
R304	X AXIS GAIN
R307	CH1 TRIG DC OFFSET
R317	CH2 TRIG DC OFFSET
R402	ADD BAL
R408	High freq range
R409	Middle freq range
R446	Low freq range
R447	High freq range
R448	High freq range, front edge of square wave
R469	Y AXIS ALIGN

C105	CH1 0.1V (1/10) input cap
C106	CH1 0.1V (1/10) phase comp
C108	CH1 1V (1/100) input cap
C109	CH1 1V (1/100) phase comp
C112	CH1 10mV input cap
C113	CH1 10mV phase comp
C115	CH1 20mV input cap
C116	CH1 20mV phase comp
C118	CH1 50mV input cap
C119	CH1 50mV phase comp
C133	CH1 higher freq range
C143	CH1 higher middle freq range
C205	CH2 0.1V (1/10) input cap
C206	CH2 0.1V (1/10) phase comp
C208	CH2 1V (1/100) input cap
C209	CH2 1V (1/100) phase comp
C212	CH2 10mV input cap
C213	CH2 10mV phase comp
C215	CH2 20mV input cap
C216	CH2 20mV phase comp
C218	CH2 50mV input cap
C219	CH2 50mV phase comp
C233	CH2 higher freq range
C243	CH2 higher middle freq range
C403	High freq range
C404	Middle freq range
C429	High freq range
C430	High freq range, front edge of square wave

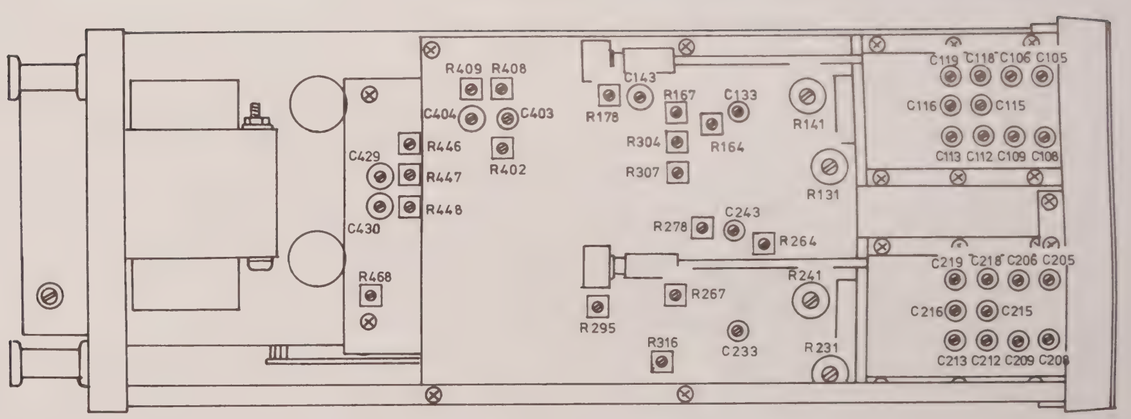
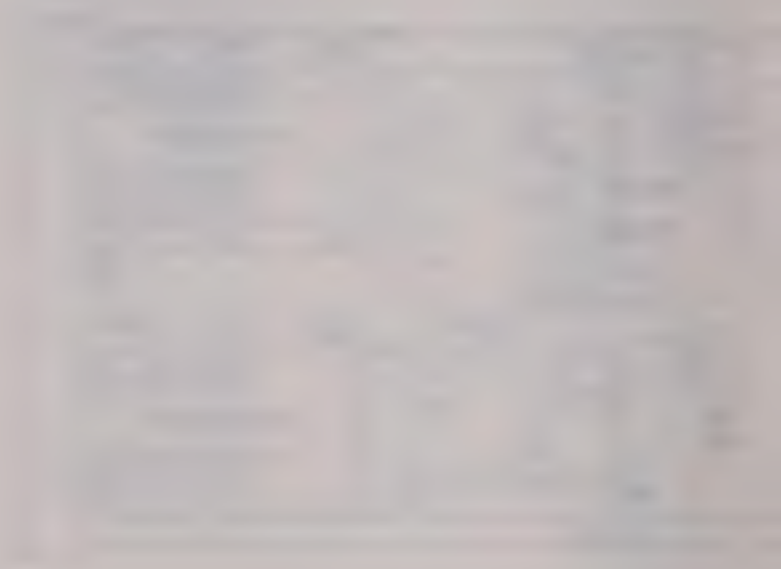


Figure 45 (Left hand side view)



R764 B START LEVEL

R769 B END LEVEL

R822 A SWEEP CAL

R871 B SWEEP CAL

R902 A SWEEP START POINT

R906 B SWEEP START POINT

R909 X-Y POSITION

R936 10 × MAG CAL

R939 10 × MAG DC BAL

C802 A SWEEP CAL (10 μsec)

C852 B SWEEP CAL (10 μsec)

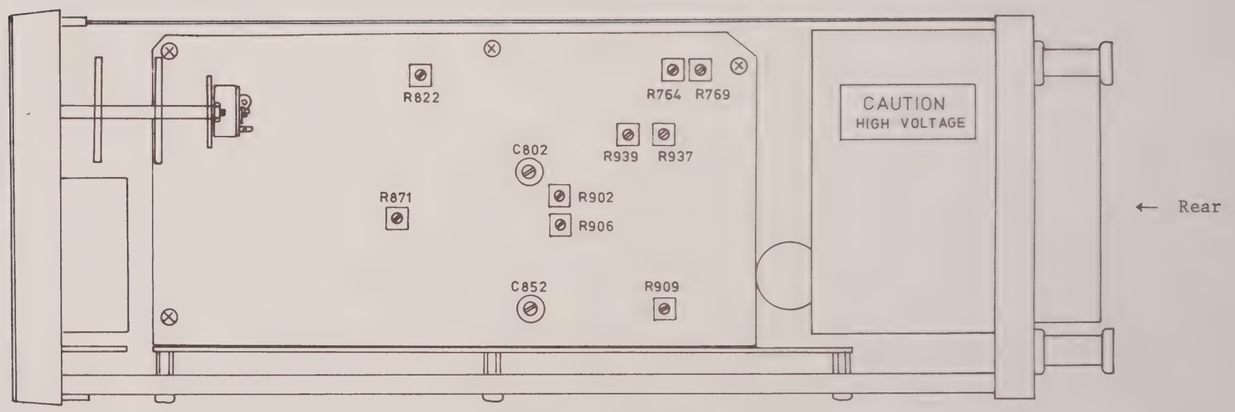


Figure 46 (Right hand side view)

7.10 Calibration of Probe

As explained previously, the probe makes up a wide-range attenuator. Unless phase compensation is properly done, the displayed waveform is distorted causing measurement errors. Therefore, the prove must be properly compensated before use.

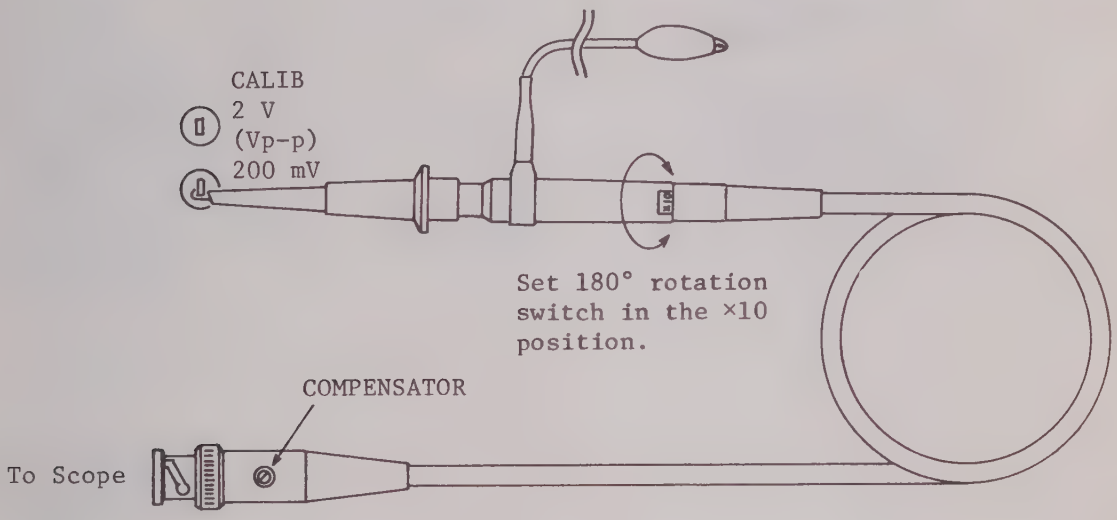


Figure 47. Calibration of the probe

Connect the probe BNC to the INPUT terminal of CH1 or CH2 and set VOLTS/DIV switch at 5 mV. Connect the probe tip to the calibration voltage output terminal and adjust the COMPENSATOR control with an insulated screwdriver so that an ideal waveform as illustrated below is obtained.

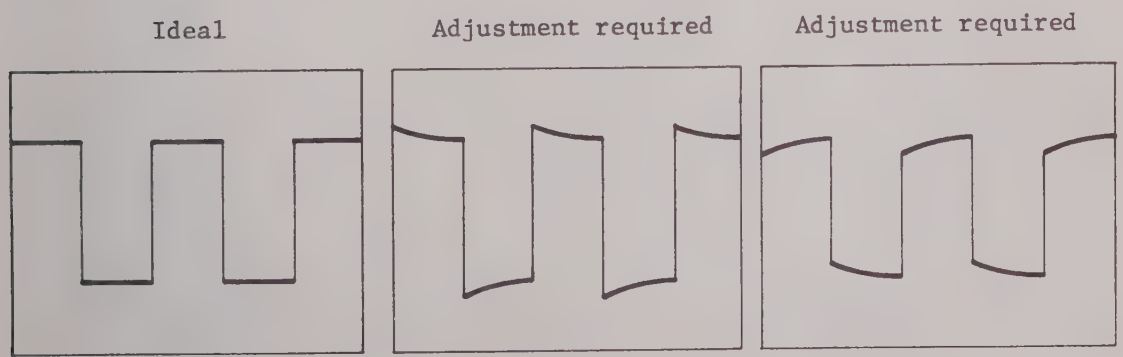
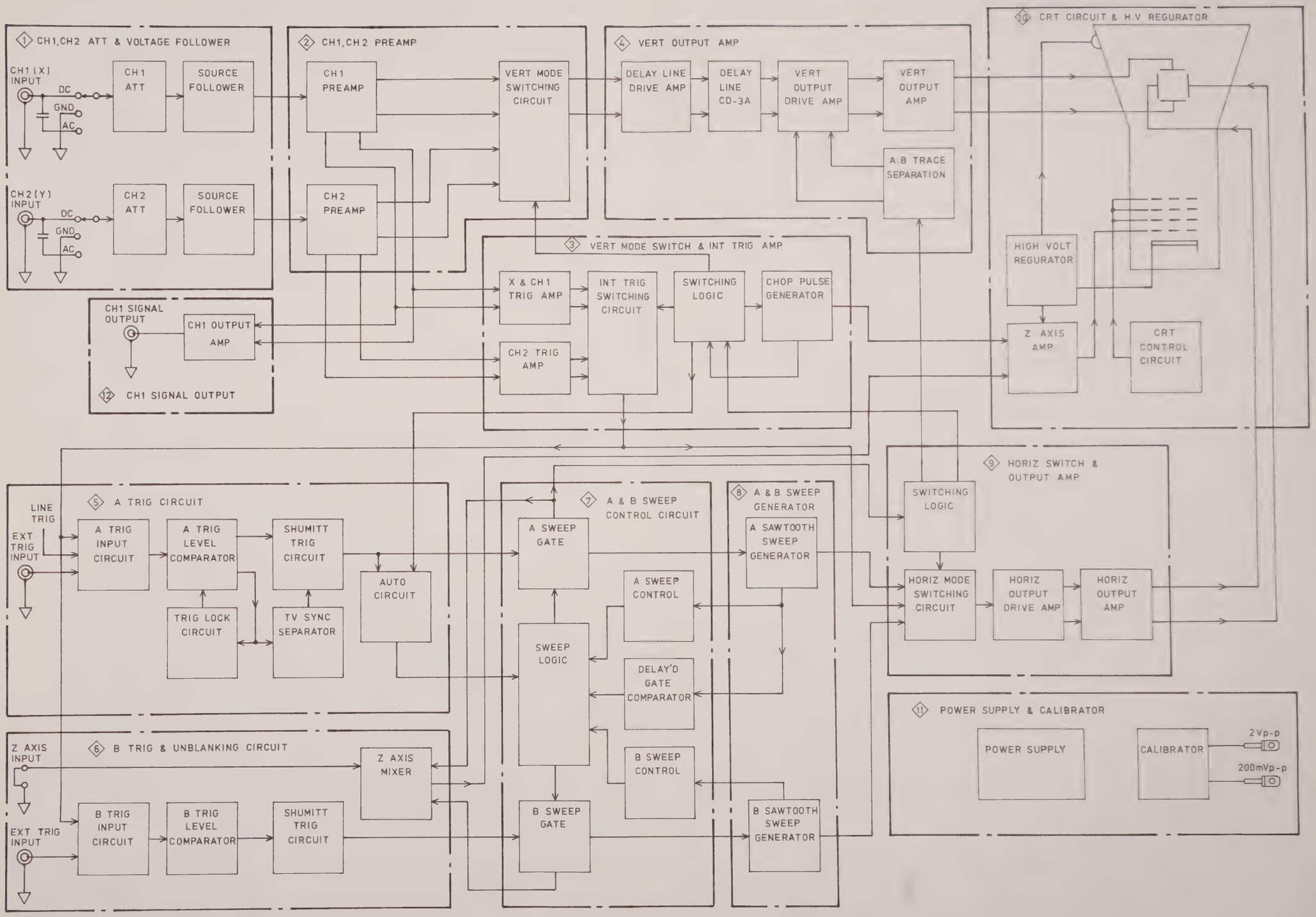


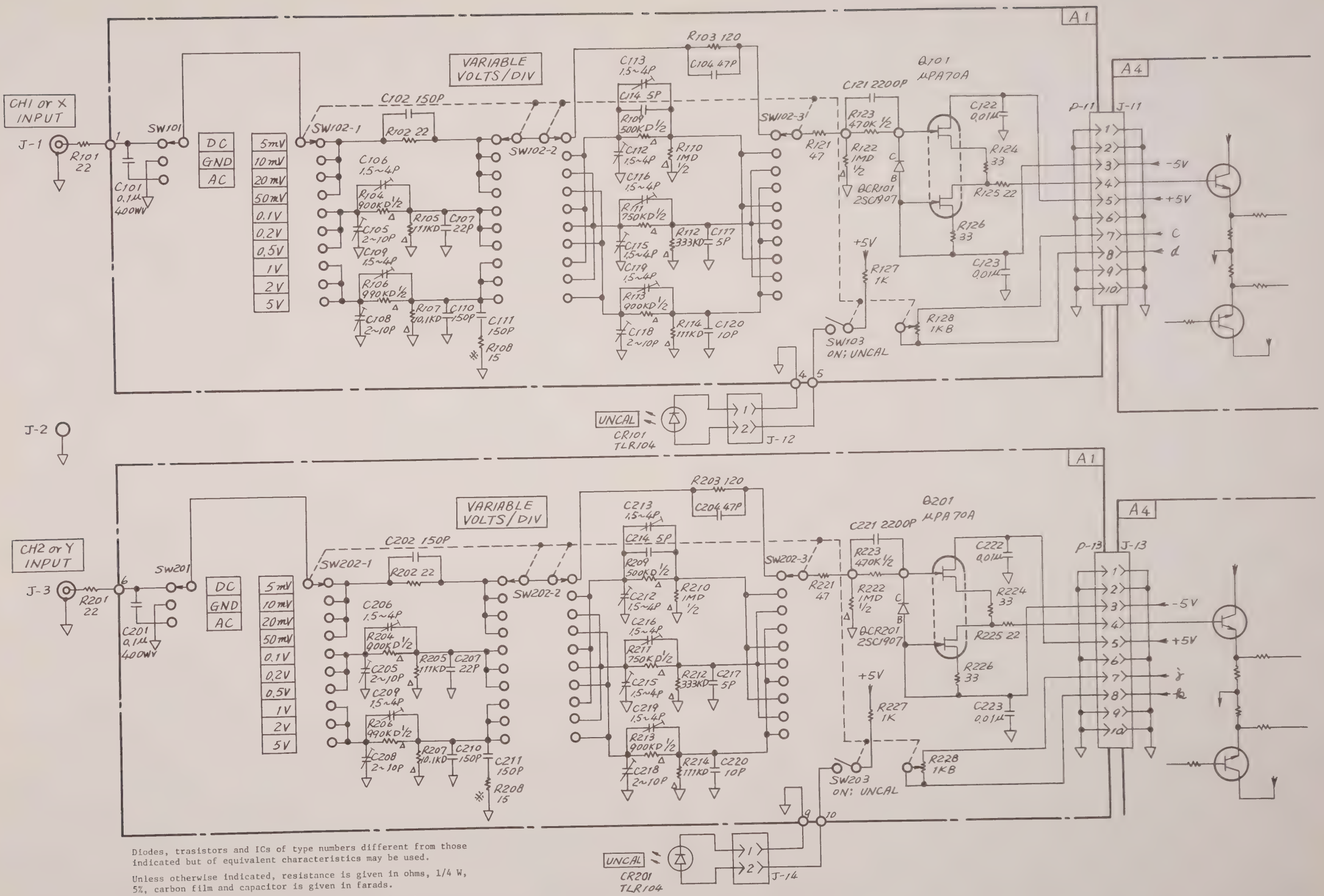
Figure 48

The accessory probe (960 BNC) is capable of switching between 10:1 and 1:1. When used with this instrument, its specifications are as follows:

Specification	10:1	1:1
Frequency response	DC - 50 MHz (within -3 dB)	DC - 6 MHz (within -3 dB)
Input resistance	10 MΩ (±3%)	1 MΩ (oscilloscope)
Input capacitance	20 pF (±10%)	Approx. 190 pF
Attenuation ratio	1/10	1/1
Maximum input voltage	600 V (DC+AC peak)	400 V (DC+AC peak)



MODEL 5630 BLOCK DIAGRAM



Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

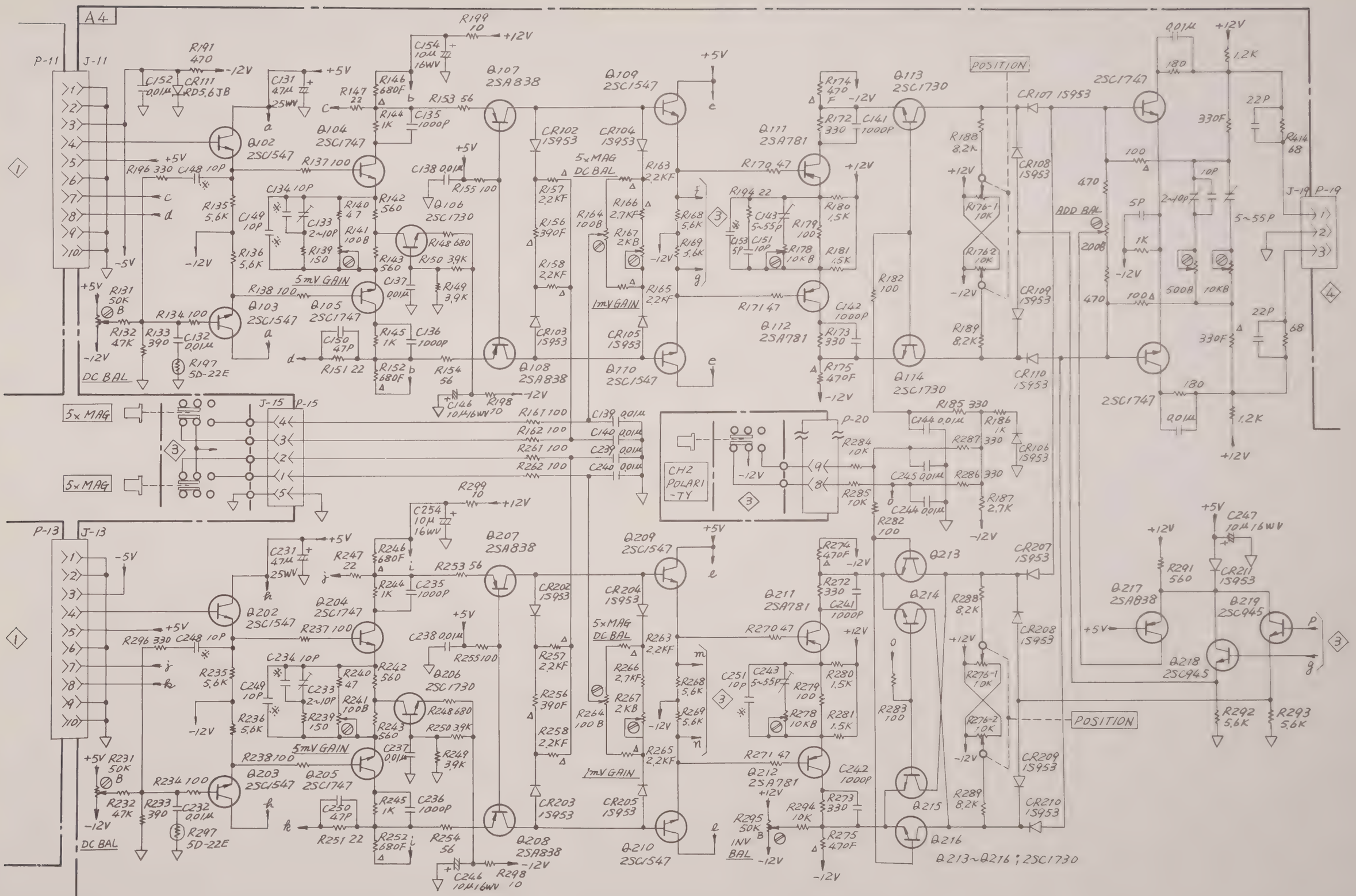
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

★ Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

CH1, CH2 ATT & VOLTAGE FOLLOWER ◇1



Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

CH1, CH2 PREAMP ◇2

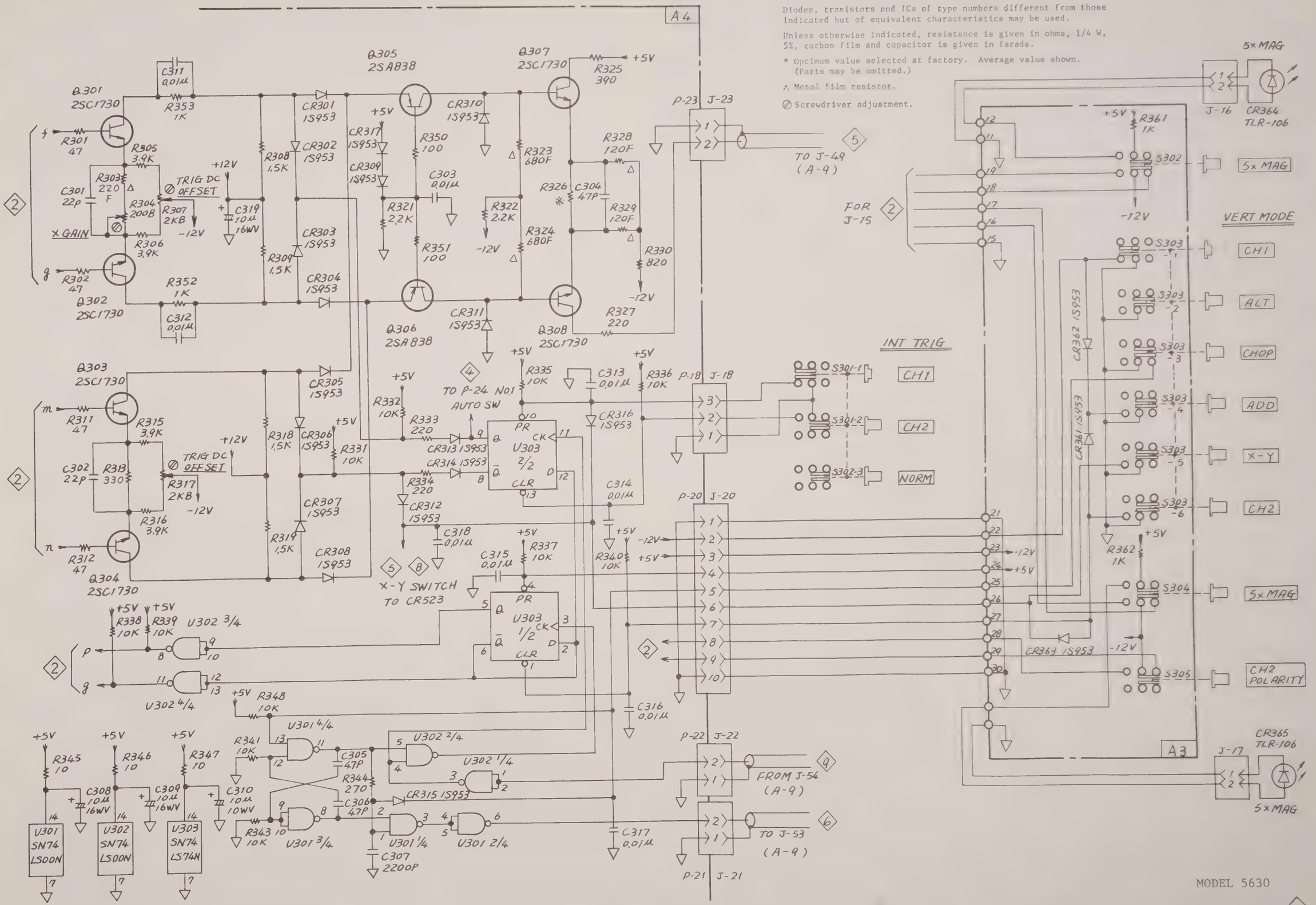
Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

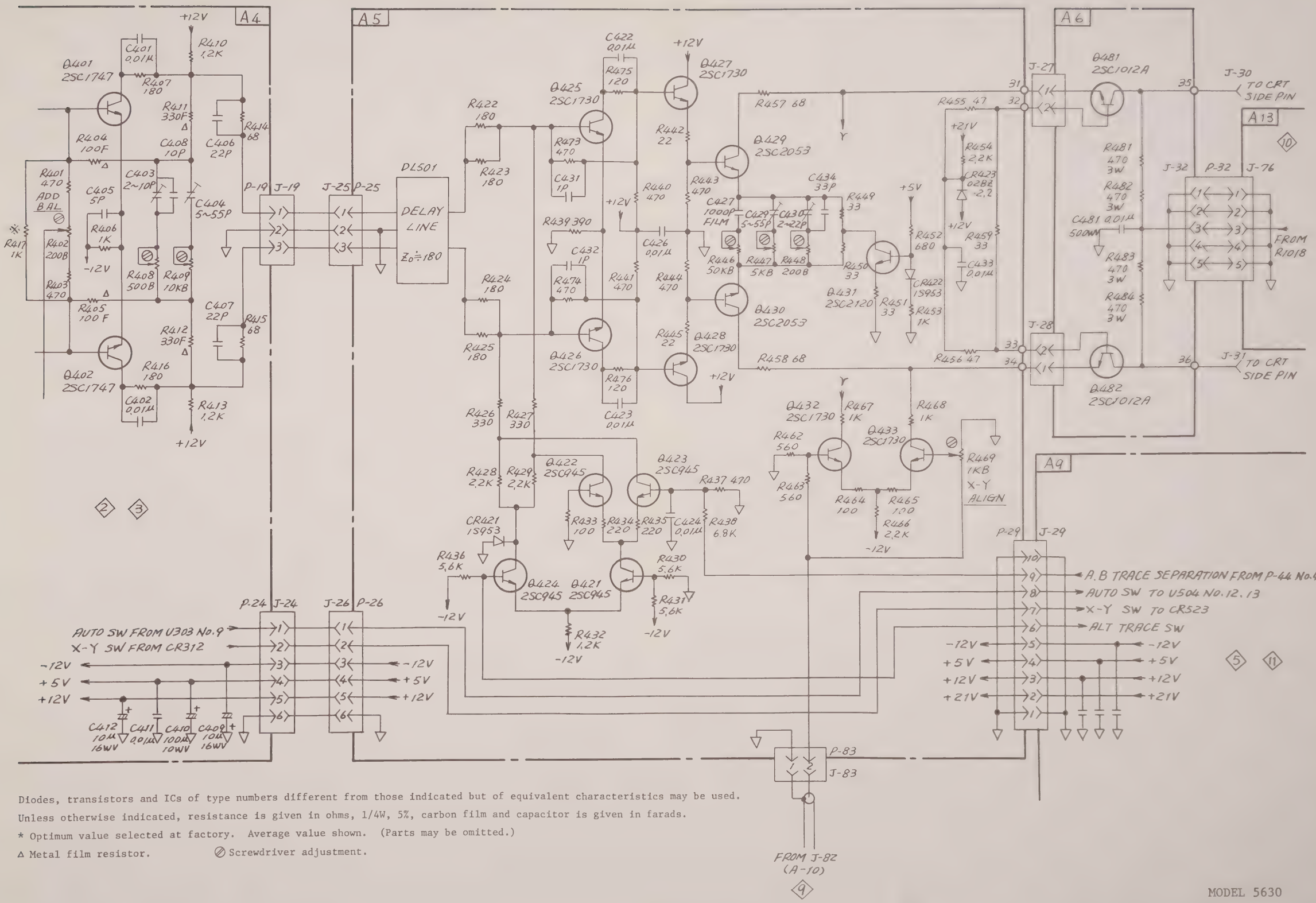
Δ Metal film resistor.

⊘ Screwdriver adjustment.



MODEL 5630

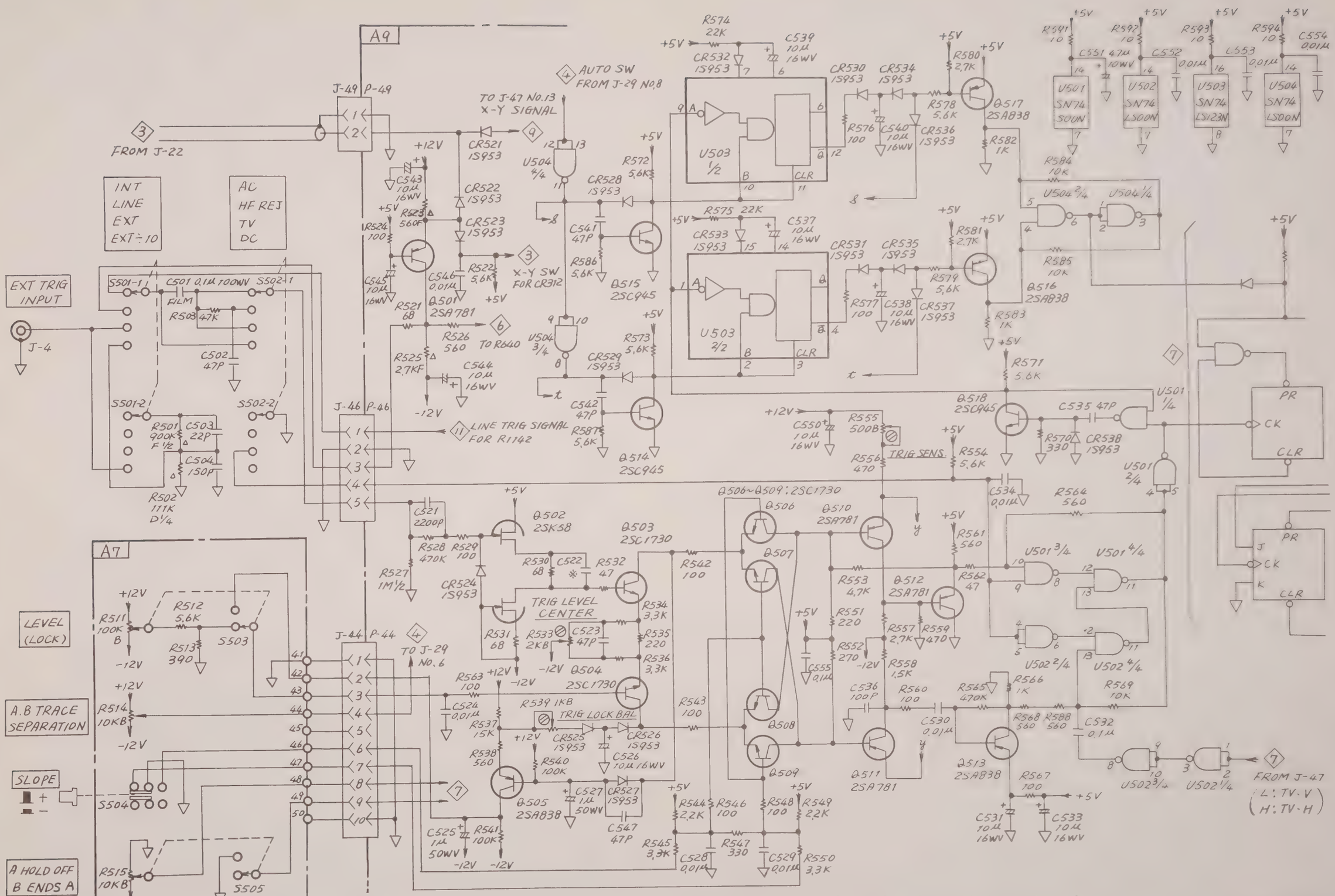
VERT MODE SWITCH & INT TRIG AMP ③



Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
Δ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

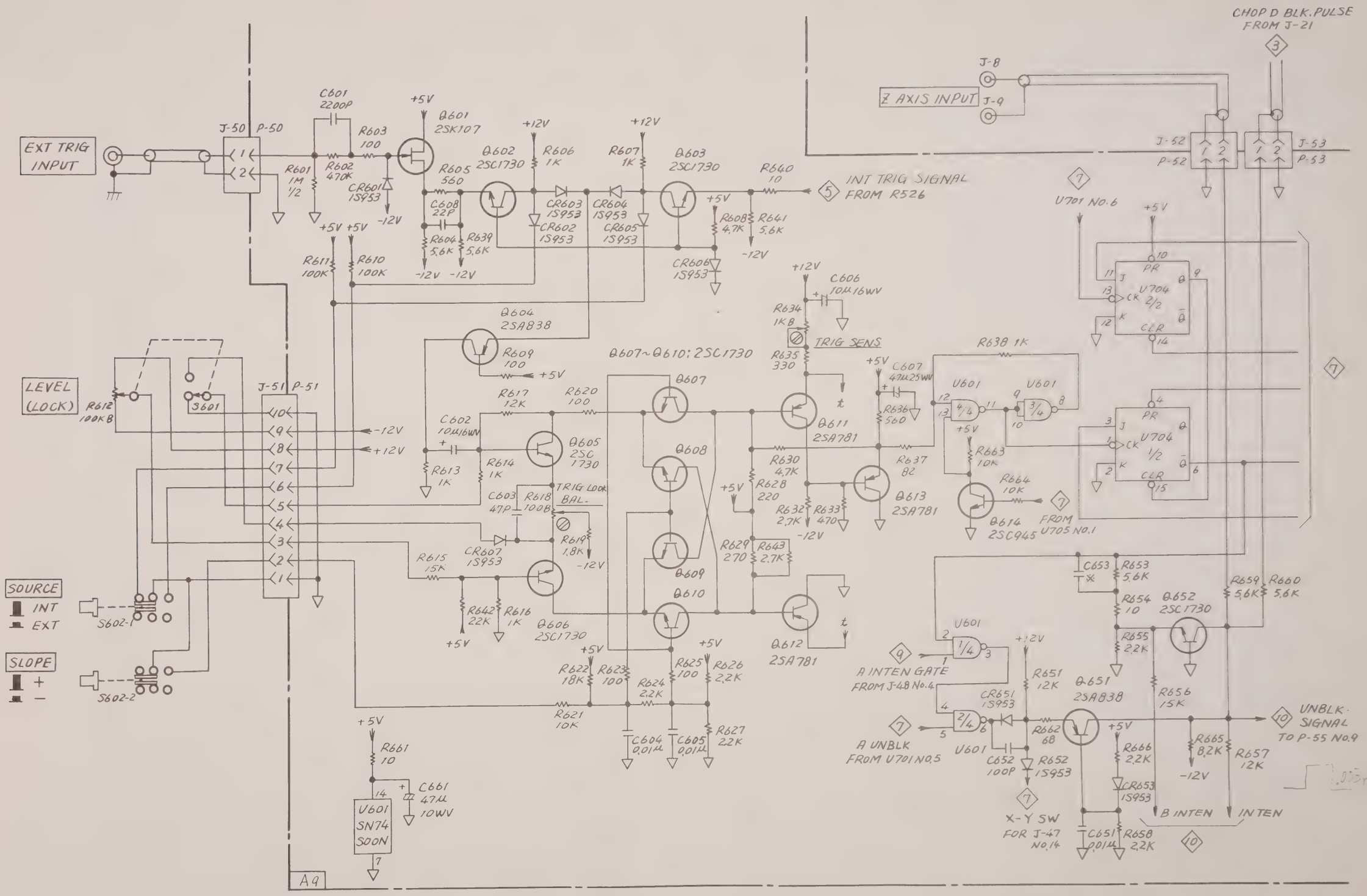
VERT MODE SWITCH & INT TRIG AMP ◇4



Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

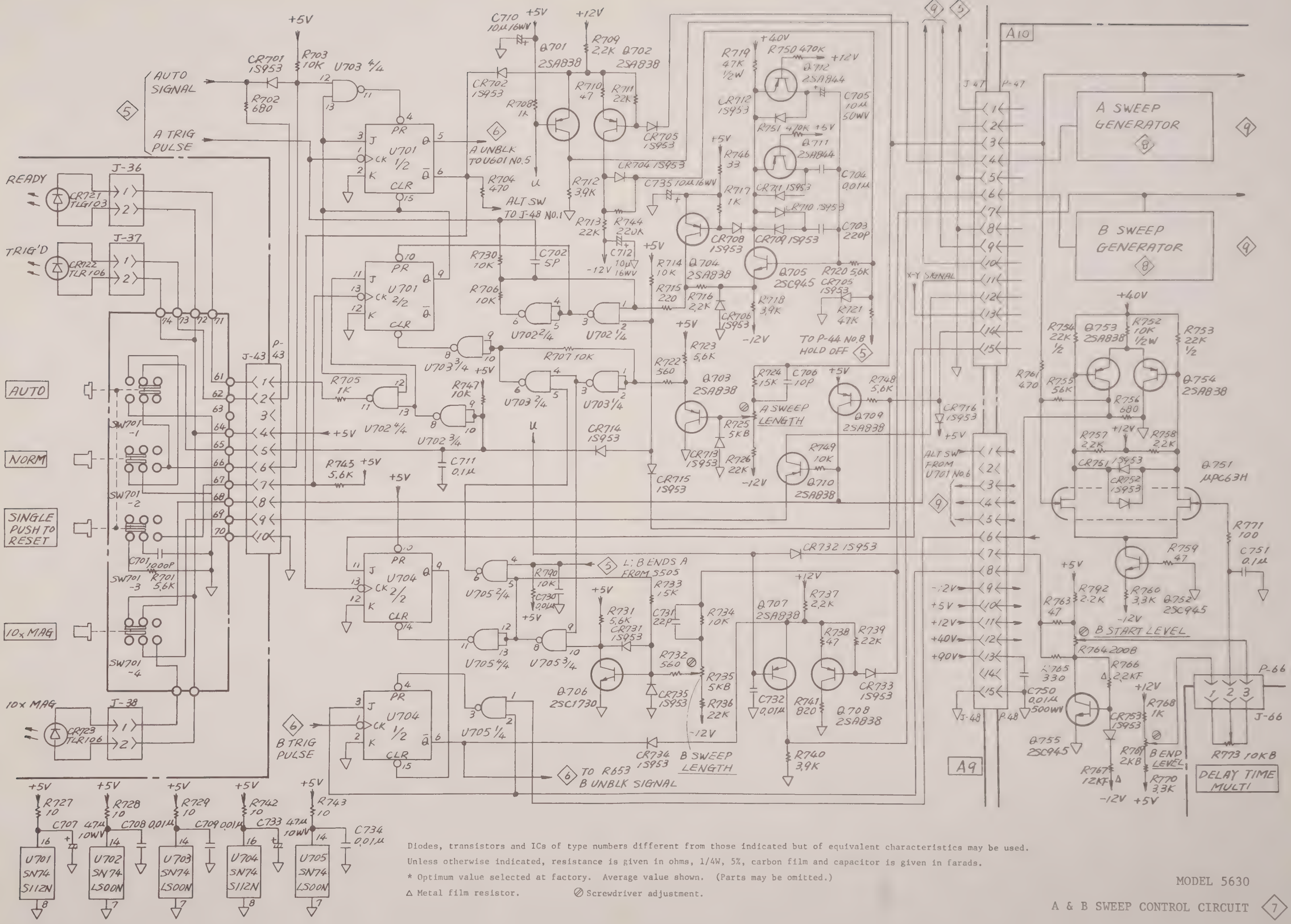
A TRIC CIRCUIT 5



Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

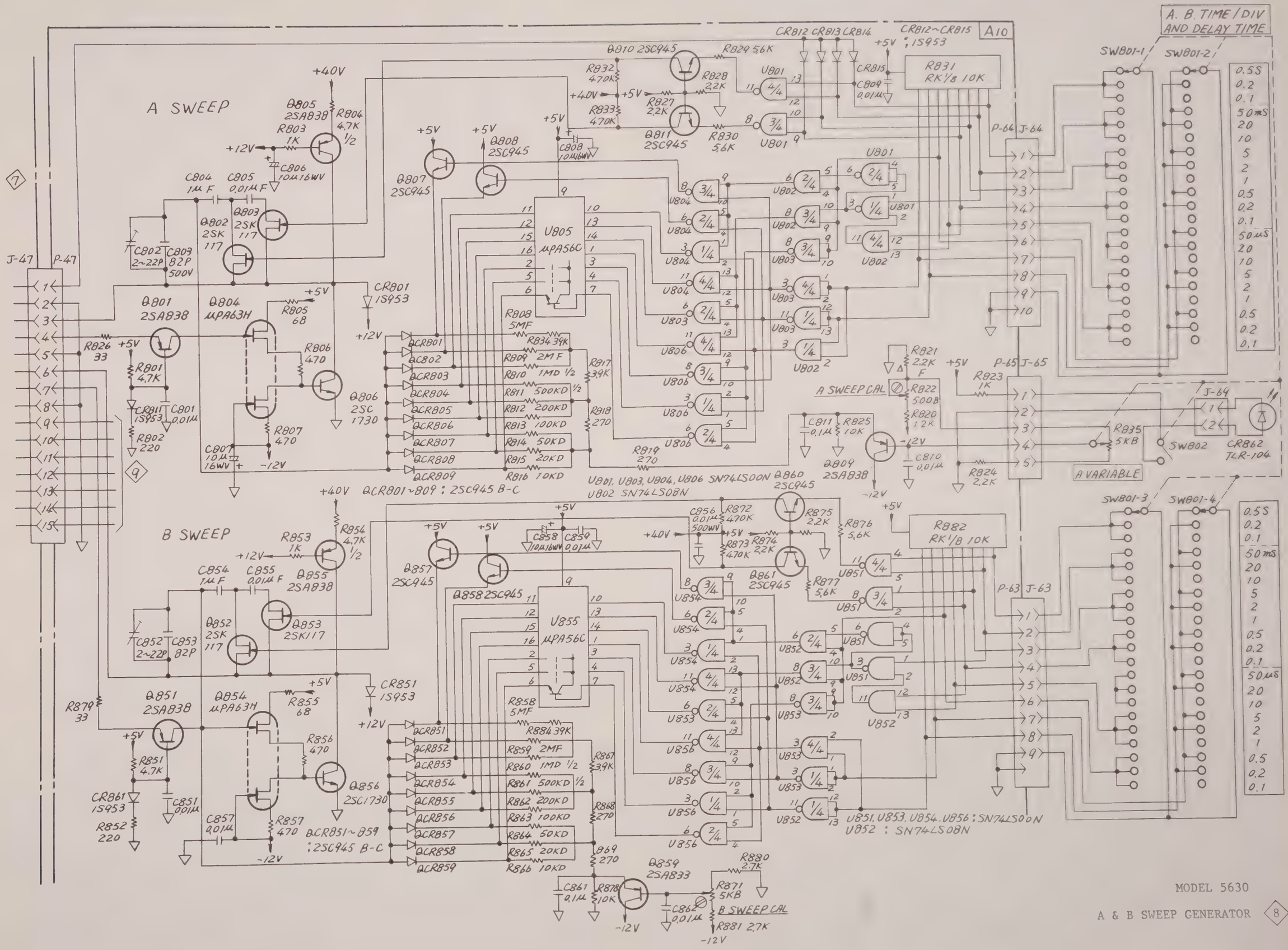
B TRIG & UNBLANKING CIRCUIT 6



Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

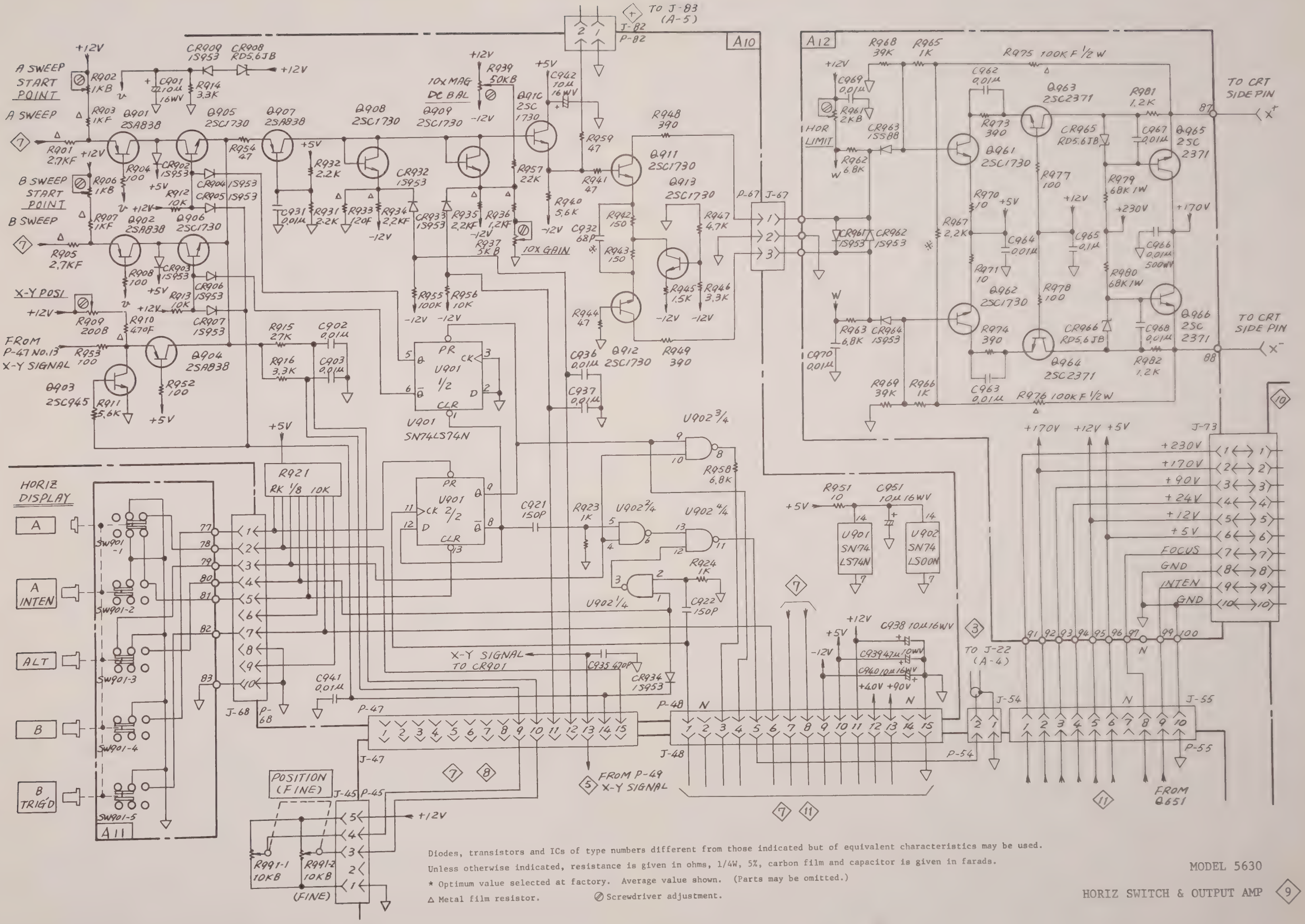
MODEL 5630

A & B SWEEP CONTROL CIRCUIT ◇7



MODEL 5630

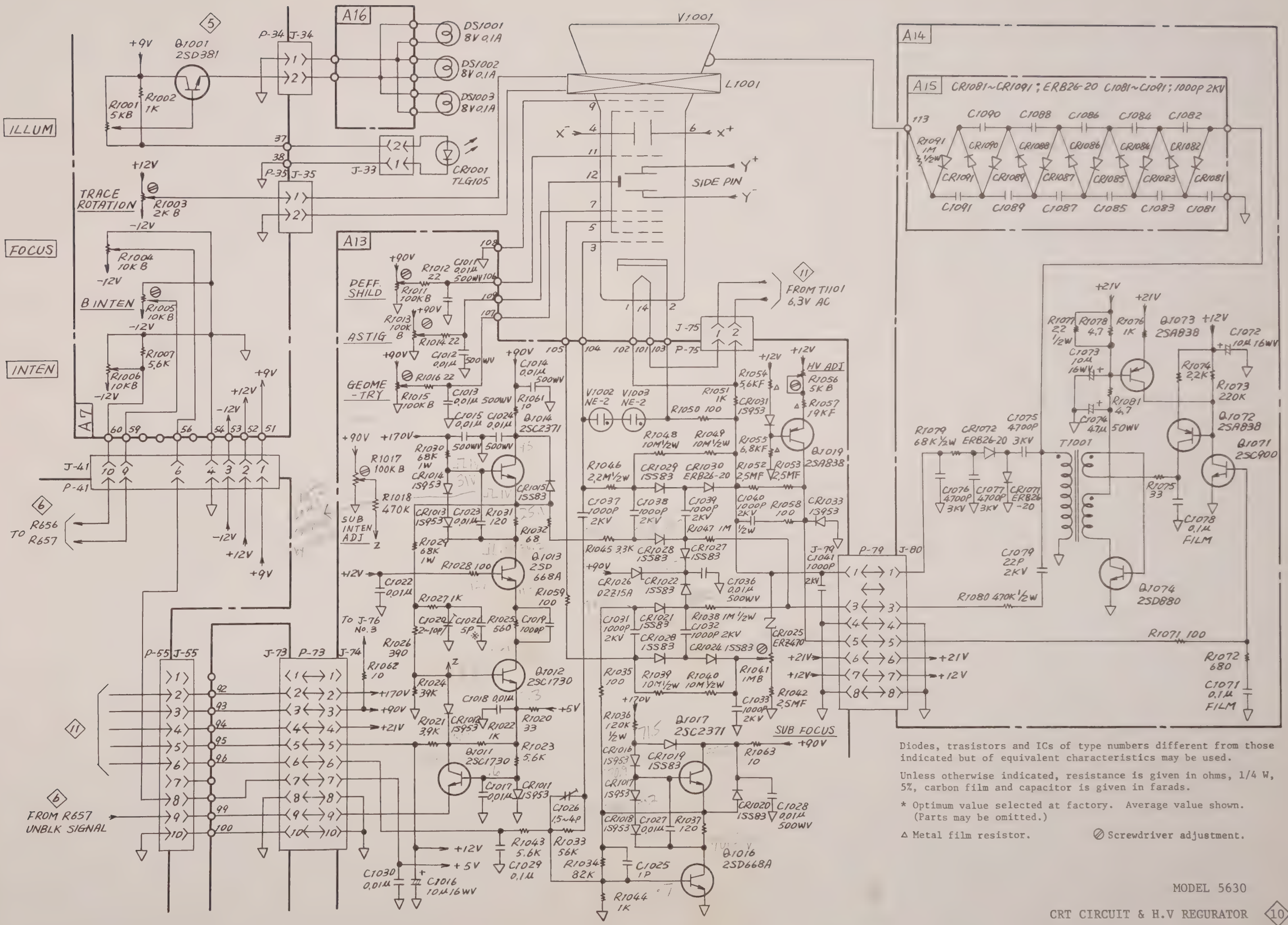
A & B SWEEP GENERATOR ◇8



Diodes, transistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.
Unless otherwise indicated, resistance is given in ohms, 1/4W, 5%, carbon film and capacitor is given in farads.
* Optimum value selected at factory. Average value shown. (Parts may be omitted.)
△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

HORIZ SWITCH & OUTPUT AMP 9



Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

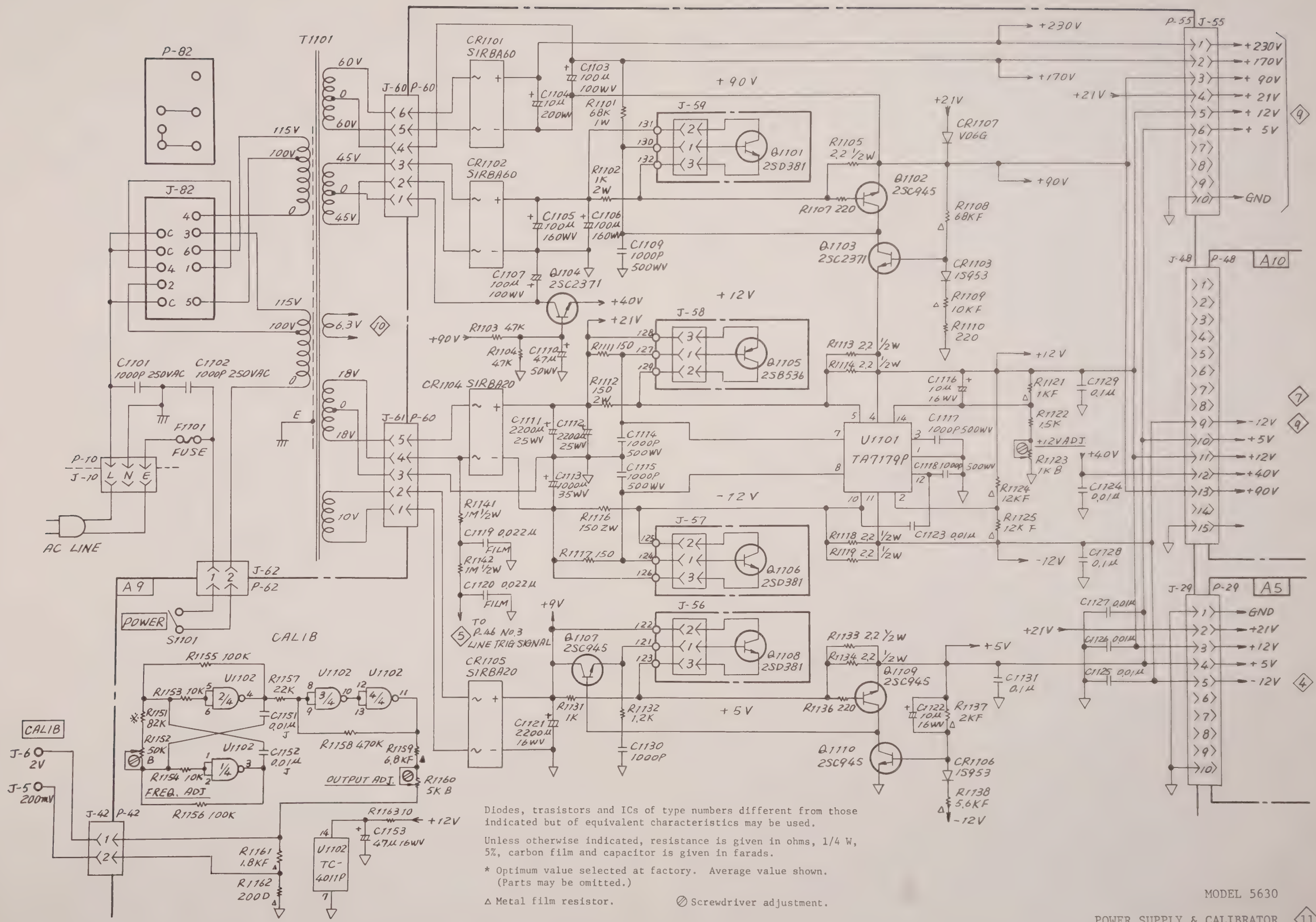
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

CRT CIRCUIT & H.V REGURATOR ◇10



Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

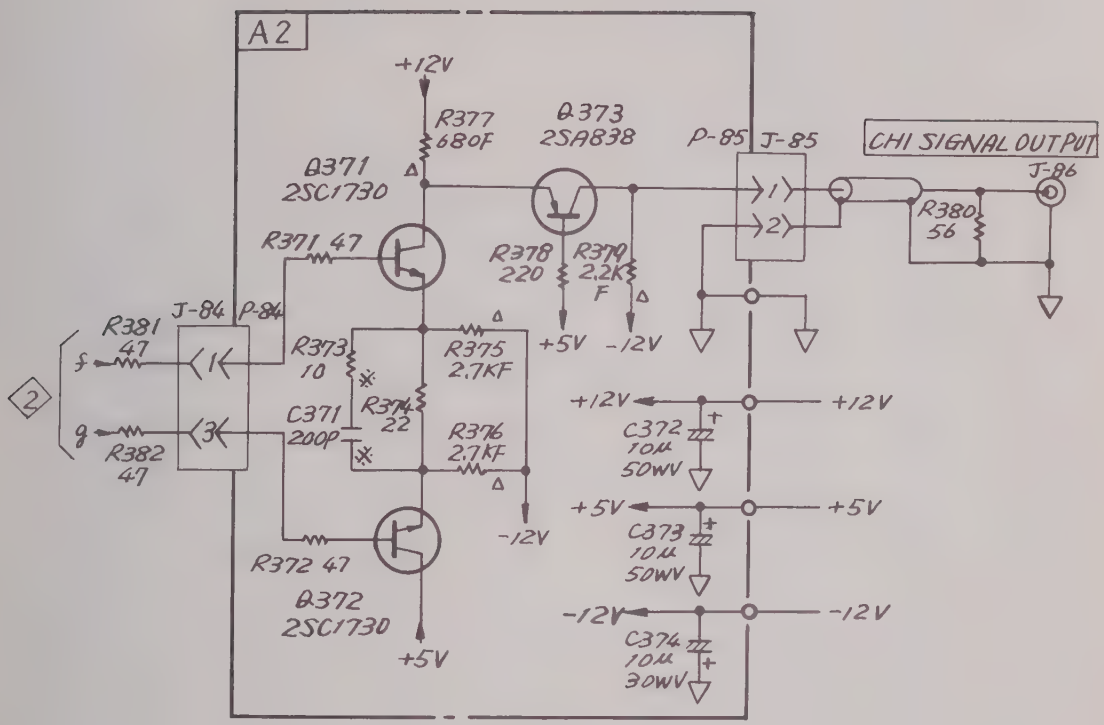
Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

△ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

POWER SUPPLY & CALIBRATOR 11



Diodes, trasistors and ICs of type numbers different from those indicated but of equivalent characteristics may be used.

Unless otherwise indicated, resistance is given in ohms, 1/4 W, 5%, carbon film and capacitor is given in farads.

* Optimum value selected at factory. Average value shown. (Parts may be omitted.)

Δ Metal film resistor. ⊘ Screwdriver adjustment.

MODEL 5630

CH1 SIGNAL OUTPUT 12

REPLACEABLE PARTS

ABBREVIATIONS

CER:	ceramic
C FILM:	carbon film
C COMP:	carbon composition
CRT:	cathode ray tube
ELECT:	electrolytic
FET:	field effect transistor
FXD:	fixed
LED:	light emitting diode
M FILM:	metal film
M GLAZE:	metal glaze
M OX:	metal oxide
M PLSTC FILM:	metallized plastic film
PLSTC FILM:	plastic film
TANT ELECT:	tantalum electrolytic
VAR:	variable
W W:	wirewound

*:	Optimum value selected at factory.
	Average value shown. (Parts may be omitted.)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A1 PCB-S A1	90-50-2010	PC BOARD A1 VERT ATT
C101	50-87-0500	C FXD PLSTC 0.1μF 400V
C102	52-06-2245	C FXD CER 150PF 50V
C104	52-06-3185	C FXD CER 47PF 500V
C105	47-10-1190	C VAR CER 2-10PF
C106	57-10-1180	C VAR CER 1.5-4PF
C107	52-06-3145	C FXD CER 22PF 500V
C108	57-10-1190	C VAR CER 2-10PF
C109	57-10-1180	C VAR CER 1.5-4PF
C110	52-06-2245	C FXD CER 150PF 50V
C111	52-06-2245	C FXD CER 150PF 50V
C112	57-10-1180	C VAR CER 1.5-4PF
C113	57-10-1180	C VAR CER 1.5-4PF
C114	52-06-3051	C FXD CER 5PF 500V
C115	57-10-1180	C VAR CER 1.5-4PF
C116	57-10-1180	C VAR CER 1.5-4PF
C117	52-06-3051	C FXD CER 5PF 500V
C118	57-10-1190	C VAR CER 2-10PF
C119	57-10-1180	C VAR CER 1.5-4PF
C120	52-06-3102	C FXD CER 10PF 500V
C121	52-01-3385	C FXD CER 2200PF 500V
C122	52-05-2468	C FXD CER 0.01μF 50V
C123	52-05-2468	C FXD CER 0.01μF 50V
C201	50-87-0500	C FXD PLSTC 0.1μF 400V
C202	52-06-2245	C FXD CER 150PF 50V
C204	52-06-3185	C FXD CER 47PF 500V
C205	57-10-1190	C VAR CER 2-10PF
C206	57-10-1180	C VAR CER 1.5-4PF
C207	52-06-3145	C FXD CER 22PF 500V
C208	57-10-1190	C VAR CER 2-10PF
C209	57010-1180	C VAR CER 1.5-4PF
C210	52-06-2245	C FXD CER 150PF 50V
C211	52-06-2245	C FXD CER 150PF 50V
C212	57-10-1180	C VAR CER 1.5-4PF
C213	57-10-1180	C VAR CER 1.5-4PF
C214	52-06-3051	C FXD CER 5PF 500V
C215	57-10-1180	C VAR CER 1.5-4PF
C216	57-10-1180	C VAR CER 1.5-4PF
C217	52-06-3051	C FXD CER 5PF 500V
C218	57-10-1190	C VAR CER 2-10PF
C219	57-10-1180	C VAR CER 1.5-4PF
C220	52-06-3102	C FXD CER 10PF 500V
C221	52-01-3385	C FXD CER 2200PF 500V
C222	52-05-2468	C FXD CER 0.01μF 50V
C223	52-05-2468	C FXD CER 0.01μF 50V
Q101	31-90-0070	FET DUAL VGS1-VGS2=5mV μPA70A NEC
Q201	31-90-0070	FET DUAL VGS1-VGS2=5mV μPA70A NEC
QCR101	30-31-9071	TR SI 2SC1907 DIODE CONNECTION HITACHI
QCR201	30-31-9071	TR SI 2SC1907 DIODE CONNECTION HITACHI
R102	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R103	40-27-1122	R FXD C FILM 120Ω 5% 1/4W
R104	42-73-4900	R FXD M FILM 900KΩ 0.5% 1/2W
R105	42-71-4111	R FXD M FILM 111KΩ 0.5% 1/4W
R106	42-73-4990	R FXD M FILM 990KΩ 0.5% 1/2W
R107	42-71-3101	R FXD M FILM 10.1KΩ 0.5% 1/4W
R108*	40-27-0152	R FXD C FILM 15Ω 5% 1/4W
R109	42-73-4500	R FXD M FILM 500KΩ 0.5% 1/2W
R110	42-73-5100	R FXD M FILM 1MΩ 0.5% 1/2W
R111	42-73-4750	R FXD M FILM 750KΩ 0.5% 1/2W
R112	42-71-4333	R FXD M FILM 333KΩ 0.5% 1/4W
R113	42-73-4900	R FXD M FILM 900KΩ 0.5% 1/2W
R114	42-71-4111	R FXD M FILM 111KΩ 0.5% 1/4W
R121	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R122	42-73-5100	R FXD M FILM 1MΩ 0.5% 1/2W
R123	40-37-4471	R FXD C FILM 470KΩ 5% 1/2W
R124	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R125	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R126	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R127	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R128 (WITH SW103)	45-01-0400	R VAR C COMP 1KΩ WITH SW
R202	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R203	40-27-1122	R FXD C FILM 120Ω 5% 1/4W
R204	42-73-4900	R FXD M FILM 900KΩ 0.5% 1/2W
R205	42-71-4111	R FXD M FILM 111KΩ 0.5% 1/4W
R206	42-73-4990	R FXD M FILM 990KΩ 0.5% 1/2W
R207	42-71-3101	R FXD M FILM 10.1KΩ 0.5% 1/4W
R208*	40-27-0152	R FXD C FILM 15Ω 5% 1/4W
R209	42-73-4500	R FXD M FILM 500KΩ 0.5% 1/2W
R210	42-73-5100	R FXD M FILM 1MΩ 0.5% 1/2W
R211	42-73-4750	R FXD M FILM 750KΩ 0.5% 1/2W
R212	42-71-4333	R FXD M FILM 333KΩ 0.5% 1/4W
R213	42-73-4900	R FXD M FILM 900KΩ 0.5% 1/2W
R214	42-71-4111	R FXD M FILM 111KΩ 0.5% 1/4W
R221	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R222	42-73-5100	R FXD M FILM 1MΩ 0.5% 1/2W
R223	40-37-4471	R FXD C FILM 470KΩ 5% 1/2W
R224	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R225	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R226	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R227	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R228 (WITH SW203)	45-01-0400	R VAR C COMP 1KΩ WITH SW
SW101	82-71-0050	SW LEVER (AC/DC/GND) J19-123
SW102	80-10-3020	SW ROTARY (VOLT/DIV)
SW103	-	SEE R128 (A PART OF R128)
SW201	82-71-0050	SW LEVER (AC/DC/GND) J19-123
SW202	80-10-3020	SW ROTARY (VOLT/DIV)
SW203	-	SEE R228 (A PART OF R228)

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A2 PCB-S A2	90-50-2021	PC BOARD-A2 CH1 SIGNAL OUT
C371*	50-76-2020	C FXD PLSTC 200PF 250V
C372	54-00-0311	C FXD ELECT 10μF 50V
C373	54-00-0311	C FXD ELECT 10μF 50V
C374	54-00-0311	C FXD ELECT 10μF 50V
C375*	52-06-2265	C FXD CER 220PF 50V
Q371	30-31-7301	TR Si NPN 2SC1730-L NEC
Q372	30-31-7301	TR Si NPN 2SC1730-L NEC
Q373	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
R371	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R372	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R373*	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R374	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R375	40-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R376	40-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R377	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R378	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R379	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
A3 PCB-S A3	90-50-2030	PC BOARD - A3 VERT MODE SW
CR361	32-11-5880	DIODE SI 1S1588 TOSHIBA
CR362	32-11-5880	DIODE SI 1S1588 TOSHIBA
CR363	32-11-5880	DIODE SI 1S1588 TOSHIBA
R361	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R362	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
S302	81-01-0300	SW PUSH KSD1-2-0 LLDC
S303	81-06-0030	SW PUSH KSD6-12-10 TLDC
S304	81-01-0360	SW PUSH SUB12 NO 348004365
S305	81-01-0360	SW PUSH SUB12 NO 348004365
A4 PCB-D A4	90-50-2040	PC BOARD - A4 VERT PREAMP
C131	54-00-0114	C FXD ELECT 47μF 25V
C132	52-05-2468	C FXD CER 0.01μF 50V
C133	57-10-1190	C VAR CER 2-10PF
C134*	52-06-3102	C FXD CER 10PF 500V
C135	50-01-3345	C FXD CER 1000PF 500V
C136	50-01-3345	C FXD CER 1000PF 500V
C137	42-05-2468	C FXD CER 0.01μF 50V
C138	52-05-2468	C FXD CER 0.01μF 50V
C139	52-05-2468	C FXD CER 0.01μF 50V
C140	52-05-2468	C FXD CER 0.01μF 50V
C141	52-01-3345	C FXD CER 1000PF 500V
C142	52-01-3345	C FXD CER 1000PF 500V
C143	57-10-1140	C VAR CER 5-55PF
C144	52-05-2468	C FXD CER 0.01μF 50V
C146	54-00-0311	C FXD ELECT 10μF 50V
C148*	52-06-3102	C FXD CER 10PF 500V
C149*	52-06-3102	C FXD CER 10PF 500V
C150	52-06-3185	C FXD CER 47PF 500V
C151*	52-06-3102	C FXD CER 10PF 500V
C152	52-05-2468	C FXD CER 0.01μF 50V
C153*	52-06-3051	C FXD CER 5PF 500V
C154	54-00-0311	C FXD ELECT 10μF 50V
C231	54-00-0114	C FXD ELECT 47μF 25V
C232	52-05-2468	C FXD CER 0.01μF 50V
C233	57-10-1190	C VAR CER 2-10PF
C234*	52-06-3102	C FXD CER 10PF 500V
C235	50-01-3345	C FXD CER 1000PF 500V
C236	50-01-3345	C FXD CER 1000PF 500V
C237	52-05-2468	C FXD CER 0.01μF 50V
C238	52-05-2468	C FXD CER 0.01μF 50V
C239	52-05-2468	C FXD CER 0.01μF 50V
C240	52-05-2468	C FXD CER 0.01μF 50V
C241	52-01-3345	C FXD CER 1000PF 500V
C242	52-01-3345	C FXD CER 1000PF 500V
C243	57-10-1140	C VAR CER 5-55PF
C244	52-05-2468	C FXD CER 0.01μF 50V
C245	52-05-2468	C FXD CER 0.01μF 50V
C246	54-00-0311	C FXD ELECT 10μF 50V
C247	54-00-0311	C FXD ELECT 10μF 50V
C248*	52-06-3102	C FXD CER 10PF 500V
C249*	52-06-3102	C FXD CER 10PF 500V
C250	52-06-3185	C FXD CER 47PF 500V
C251*	52-06-3102	C FXD CER 10PF 500V
C254	54-00-0311	C FXD ELECT 10μF 50V
C301	52-06-3145	C FXD CER 22PF 500V
C302	52-06-3145	C FXD CER 22PF 500V
C303	52-05-2468	C FXD CER 0.01μF 50V
C304	52-06-3185	C FXD CER 47PF 500V
C305	52-06-3185	C FXD CER 47PF 500V
C306	52-06-3185	C FXD CER 47PF 500V
C307	52-01-3385	C FXD CER 2200PF 500V
C308	54-00-0311	C FXD ELECT 10μF 50V
C309	54-00-0311	C FXD ELECT 10μF 50V
C310	54-00-0311	C FXD ELECT 10μF 50V
C311	52-05-2468	C FXD CER 0.01μF 50V
C312	52-05-2468	C FXD CER 0.01μF 50V
C313	52-05-2468	C FXD CER 0.01μF 50V
C314	52-05-2468	C FXD CER 0.01μF 50V
C315	52-05-2468	C FXD CER 0.01μF 50V
C316	52-05-2468	C FXD CER 0.01μF 50V
C317	52-05-2468	C FXD CER 0.01μF 50V
C318	52-05-2468	C FXD CER 0.01μF 50V
C319	54-00-0311	C FXD ELECT 10μF 50V
C401	52-05-2468	C FXD CER 0.01μF 50V
C402	52-05-2468	C FXD CER 0.01μF 50V
C403	57-10-1190	C VAR CER 2-10PF
C404	57-10-1140	C VAR CER 5-55PF
C405	52-06-3051	C FXD CER 5PF 500V
C406	52-06-3145	C FXD CER 22PF 500V
C407	52-06-3145	C FXD CER 22PF 500V
C408	52-06-3102	C FXD CER 10PF 500V

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A4 C409	54-00-0311	C FXD ELECT 10μF 50V
C410	54-00-0121	C FXD ELECT 100μF 25V
C411	54-05-2468	C FXD CER 0.01μF 50V
C412	52-00-0311	C FXD ELECT 10μF 50V
CR102-CR110	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR111	32-91-1800	DIODE ZENER RD5.6JB NEC
CR202-CR205	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR207-CR211	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR301-CR317	32-11-5880	DIODE Si 1S1588 TOSHIBA
Q102	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q103	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q104	30-31-7470	TR Si NPN 2SC1747 HITACHI
Q105	30-31-7470	TR Si NPN 2SC1747 HITACHI
Q106	30-31-7301	TR Si NPN 2SC1730-L NEC
Q107	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q108	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q109	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q110	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q111	30-10-7810	TR Si PNP 2SA781 HITACHI
Q112	30-10-7810	TR Si PNP 2SA781 HITACHI
Q113	30-31-7301	TR Si NPN 2SC1730-L NEC
Q114	30-31-7301	TR Si NPN 2SC1730-L NEC
Q202	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q203	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q204	30-31-7470	TR Si NPN 2SC1747 HITACHI
Q205	30-31-7470	TR Si NPN 2SC1747 HITACHI
Q206	30-31-7301	TR Si NPN 2SC1730-L NEC
Q207	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q208	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q209	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q210	30-31-5470	TR Si NPN 2SC1547 MATSUSHITA
Q211	30-10-7810	TR Si PNP 2SA781 HITACHI
Q212	30-10-7810	TR Si PNP 2SA781 HITACHI
Q213	30-31-7301	TR Si NPN 2SC1730-L NEC
Q214	30-31-7301	TR Si NPN 2SC1730-L NEC
Q215	30-31-7301	TR Si NPN 2SC1730-L NEC
Q216	30-31-7301	TR Si NPN 2SC1730-L NEC
Q217	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q218	30-30-9451	TR Si NPN 2SC945-Q NEC
Q219	30-30-9451	TR Si NPN 2SC945-Q NEC
Q301	30-31-7301	TR Si NPN 2SC1730-L NEC
Q302	30-31-7301	TR Si NPN 2SC1730-L NEC
Q303	30-31-7301	TR Si NPN 2SC1730-L NEC
Q304	30-31-7301	TR Si NPN 2SC1730-L NEC
Q305	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q306	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q307	30-31-7301	TR Si NPN 2SC1730-L NEC
Q308	30-31-7301	TR Si NPN 2SC1730-L NEC
Q401	30-31-7470	TR Si NPN 2SC1747 HITACHI
Q402	30-31-7470	TR Si NPN 2SC1747 HITACHI
R131	48-29-3500	R VAR M FILM 50KΩ
R132	40-27-3472	R FXD C FILM 47KΩ 5% 1/4W
R133	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R134	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R135	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R136	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R137	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R138	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R139	40-27-1152	R FXD C FILM 150Ω 5% 1/4W
R140	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R141	48-29-1100	R VAR M FILM 100Ω
R142	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R143	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R144	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R145	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R146	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R147	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R148	40-27-1682	R FXD C FILM 680Ω 5% 1/4W
R149	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R150	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R151	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R152	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R153	40-27-0562	R FXD C FILM 56Ω 5% 1/4W
R154	40-27-0562	R FXD C FILM 56Ω 5% 1/4W
R155	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R156	42-72-1390	R FXD M FILM 390Ω 1% 1/4W
R157	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R158	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R161	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R162	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R163	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R164	48-12-1101	R VAR M FILM 100Ω
R165	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R166	42-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R167	48-29-2200	R VAR M FILM 2KΩ
R168	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R169	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R170	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R171	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R172	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R173	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R174	42-72-1470	R FXD M FILM 470Ω 1% 1/4W
R175	42-72-1470	R FXD M FILM 470Ω 1% 1/4W
R176	45-02-0210	R VAR C FILM 10KΩ+10KΩ WITH SW
R178	48-29-3100	R VAR M FILM 10KΩ
R179	40-27-1102	R FXD C FILM 100Ω 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A4 R180	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R181	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R182	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R185	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R186	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R187	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R188	40-27-2822	R FXD C FILM 8.2KΩ 5% 1/4W
R189	40-27-2822	R FXD C COMP 8.2KΩ 5% 1/4W
R191	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R192*	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R193*	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R194*	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R196	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R197	38-00-0000	THERMISTOR 250Ω at 25°C α=-3.5%/C° 50-22E SHIBAURA
R198	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R199	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R231	48-29-3500	R VAR M FILM 50KΩ
R232	40-27-3472	R FXD C FILM 47KΩ 5% 1/4W
R233	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R234	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R235	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R236	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R237	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R238	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R239	40-27-1152	R FXD C FILM 150Ω 5% 1/4W
R240	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R241	48-29-1100	R VAR M FILM 100Ω
R242	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R243	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R244	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R245	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R246	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R247	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R248	40-27-1682	R FXD C FILM 680Ω 5% 1/4W
R249	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R250	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R251	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R252	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R253	40-27-0562	R FXD C FILM 56Ω 5% 1/4W
R254	40-27-0562	R FXD C FILM 56Ω 5% 1/4W
R255	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R256	42-72-1390	R FXD M FILM 390Ω 1% 1/4W
R257	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R258	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R261	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R262	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R263	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R264	48-29-1100	R VAR M FILM 100Ω
R265	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R266	42-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R267	48-29-2200	R VAR M FILM 2KΩ
R268	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R269	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R270	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R271	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R272	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R273	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R274	42-72-1470	R FXD M FILM 470Ω 1% 1/4W
R275	42-72-1470	R FXD M FILM 470Ω 1% 1/4W
R276	45-02-0210	R VAR C FILM 10KΩ+10KΩ WITH SW
R278	48-29-3100	R VAR M FILM 10KΩ
R279	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R280	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R281	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R282	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R283	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R284	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R285	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R286	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R287	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R288	40-27-2822	R FXD C FILM 8.2KΩ 5% 1/4W
R289	40-27-2822	R FXD C COMP 8.2KΩ 5% 1/4W
R291	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R292	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R293	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R294	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R295	48-29-3500	R VAR M FILM 50KΩ
R296	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R297	38-00-0000	THERMISTOR 250Ω at 25°C α=-3.5%/C° 5D-22E SHIBAURA
R298	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R299	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R301	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R302	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R303	42-72-1220	R FXD M FILM 220Ω 1% 1/4W
R304	48-29-1200	R VAR M FILM 200Ω
R305	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R306	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R307	48-29-2200	R VAR M FILM 2KΩ
R308	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R309	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R311	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R312	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R313	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R315	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R316	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R317	48-29-2200	R VAR M FILM 2KΩ
R318	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R319	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R321	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R322	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R323	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R324	42-72-1680	R FXD M FILM 680Ω 1% 1/4W
R325	40-27-1392	R FXD C FILM 390Ω 5% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
A4	R327	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
	R328	42-72-1120	R FXD M FILM 120Ω 1% 1/4W
	R329	42-72-1120	R FXD M FILM 120Ω 1% 1/4W
	R330	40-27-1822	R FXD C FILM 820Ω 5% 1/4W
	R331	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R332	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R333	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
	R334	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
	R335	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R336	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R337	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R338	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R339	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R340	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R341	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R343	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R344	40-27-1272	R FXD C FILM 270Ω 5% 1/4W
	R345	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
	R346	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
	R347	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
	R348	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
	R350	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
	R351	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
	R352	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R353	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R401	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R402	48-29-1200	R VAR M FILM 200Ω
	R403	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R404	42-72-1100	R FXD M FILM 100Ω 1% 1/4W
	R405	42-72-1100	R FXD M FILM 100Ω 1% 1/4W
	R406	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R407	40-27-1182	R FXD C FILM 180Ω 5% 1/4W
	R408	48-29-1500	R VAR M FILM 500Ω
	R409	48-29-3100	R VAR M FILM 10KΩ
	R410	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
	R411	42-72-1330	R FXD M FILM 330Ω 1% 1/4W
	R412	42-72-1330	R FXD M FILM 330Ω 1% 1/4W
	R413	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
	R414	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
	R415	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
	R416	40-27-1182	R FXD C FILM 180Ω 5% 1/4W
	R417*	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	U301	35-70-0001	IC QUAD2-INPUT NAND GATE SN74LSOON
	U302	35-70-0001	IC QUAD2-INPUT NAND GATE SN74LSOON
	U303	35-70-0741	IC DUAL D FLIPFLOP SN74LS74N
A5	PCB-S A5	90-50-2051	PCB-S A5 VERT DRIVE AMP
	C422	52-05-2468	C FXD CER 0.01μF 50V
	C423	52-05-2468	C FXD CER 0.01μF 50V
	C424	52-05-2468	C FXD CER 0.01μF 50V
	C426	52-05-2468	C FXD CER 0.01μF 50V
	C427	50-67-0000	C FXD PLSTC 0.001μF 10% 100V
	C429	57-10-1140	C VAR CER 5-55PF
	C430	57-10-1110	C VAR CER 2-22PF
	C431	52-06-3010	C FXD CER 1PF 500V
	C432	52-06-3010	C FXD CER 1PF 500V
	C433	52-05-2468	C FXD CER 0.01μF 50V
	C434	52-06-3165	C FXD CER 33PF 500V
	CR421	32-11-5880	DIODE Si 1S1588 TOSHIBA
	CR422	32-11-5880	DIODE Si 1S1588 TOSHIBA
	CR423	32-90-0780	DIODE ZENER VZ=2.2V 02BZ2.2 TOSHIBA
	DL501	91-90-0001	DELAY LINE(Z=186Ω) 2m
	Q421	30-30-9451	TR Si NPN 2SC945-Q NEC
	Q422	30-30-9451	TR Si NPN 2SC945-Q NEC
	Q423	30-30-9451	TR Si NPN 2SC945-Q NEC
	Q424	30-30-9451	TR Si NPN 2SC945-Q NEC
	Q425	30-31-7301	TR Si NPN 2SC1730-L NEC
	Q426	30-31-7301	TR Si NPN 2SC1730-L NEC
	Q427	30-31-7301	TR Si NPN 2SC1730-L NEC
	Q428	30-31-7301	TR Si NPN 2SC1730-L NEC
	Q429	30-32-0530	TR Si NPN 2SC2053 MITSUBISHI
	Q430	30-32-0530	TR Si NPN 2SC2053 MITSUBISHI
	Q431	30-32-1201	TR Si NPN 2SC2120-Y TOSHIBA
	Q432	30-31-7301	TR Si NPN 2SC1730-L NEC
	Q433	30-31-7301	TR Si NPN 2SC1730-L NEC
	R422	40-27-1182	R FXD C FILM 180Ω 5% 1/4W
	R423	40-27-1182	R FXD C FILM 180Ω 5% 1/4W
	R424	40-27-1182	R FXD C FILM 180Ω 5% 1/4W
	R425	40-27-1182	R FXD C FILM 180Ω 5% 1/4W
	R426	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
	R427	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
	R428	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
	R429	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
	R430	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
	R431	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
	R432	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
	R433	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
	R434	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
	R435	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
	R436	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
	R437	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R438	40-27-2682	R FXD C FILM 6.8KΩ 5% 1/4W
	R439	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
	R440	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R441	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R442	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
	R443	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R444	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R445	40-27-0222	R FXD C FILM 22Ω 5% 1/4W

REFERENCE DESIGNATOR		KIKUSUI PARTS NO.	DESCRIPTION
A5	R446	48-29-3500	R VAR M FILM 50KΩ
	R447	48-29-2500	R VAR M FILM 5KΩ
	R448	48-29-1200	R VAR M FILM 200Ω
	R449	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
	R450	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
	R451	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
	R452	40-27-1682	R FXD C FILM 680Ω 5% 1/4W
	R453	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R454	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
	R455	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
	R456	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
	R457	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
	R458	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
	R459	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
	R462	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
	R463	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
	R464	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
	R465	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
	R466	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
	R467	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R468	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R469	48-29-2100	R VAR M FILM 1KΩ
	R473	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R474	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
	R475	40-27-1122	R FXD C FILM 120Ω 5% 1/4W
	R476	40-27-1122	R FXD C FILM 120Ω 5% 1/4W
A6	PCB-S A6	90-50-2060	PCB-S A6 VERT OUTPUT AMP
	C481	52-03-3469	C FXD CER 0.01μF 500V
	Q481	30-31-0121	TR Si NPN 2SC1012A MATSUSHITA
	Q482	30-31-0121	TR Si NPN 2SC1012A MATSUSHITA
	R481	44-93-1470	R FXD M OX 470Ω 5% 3W
	R482	44-93-1470	R FXD M OX 470Ω 5% 3W
	R483	44-93-1470	R FXD M OX 470Ω 5% 3W
	R484	44-93-1470	R FXD M OX 470Ω 5% 3W
A7	PCB-S A7	90-50-2070	PCB-S A7 TRIG & CRT CONTROL
	Q1001	30-40-3811	TR Si NPN 2SD381-L NEC
	R511 (WITH S503)	45-01-0370	R VAR C COMP 100KΩ WITH SW RV16YP15SB 100KΩ
	R512	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
	R513	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
	R514	46-16-3101	R VAR M GLAZE 10KΩ RG161P15SB 10KΩ
	R515 (WITH S505)	45-01-0390	R VAR C COMP 10KΩ WITH SW V16L5S(C24ST+ZSC24ST)15SB 10KΩ
	R1001	46-16-2501	R VAR M GLAZE RG161P15SB 5KΩ
	R1002	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
	R1003	46-16-2201	R VAR M GLAZE RG161P 15SB 2KΩ
	R1004	46-16-3101	R VAR M GLAZE RG161P 15SB 10KΩ
	R1005	46-16-3101	R VAR M GLAZE RG161P 15SB 10KΩ
	R1006	46-16-3101	R VAR M GLAZE RG161P 15SB 10KΩ
	R1007	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
	S503	-	SEE R511 (A PART OF R511)
	S504	81-01-0300	SW PUSH KSD1-2-0 LLDC
	S505	-	SEE R515 (A PART OF R515)
A8	PCB-S A8	90-50-2080	PCB-S A8 SWEEP MODE SW
	C701	52-01-3345	C FXD CER 1000PF 500WV
	R701	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
	SW701	81-04-0150	SW PUSH KSD5-8-10 MLDC
A9	PCB-D A9	90-50-2091	PCB-D A9 TRIG & POWER SUPPLY
	C521	52-01-3385	C FXD CER 2200PF 500V
	C523	52-06-3185	C FXD CER 47PF 500V
	C524	52-05-2468	C FXD CER 0.01μF 50V
	C525	54-00-0301	C FXD ELECT 1μF 50V
	C526	54-00-0311	C FXD ELECT 10μF 50V
	C527	54-00-0301	C FXD ELECT 1μF 50V
	C528	52-05-2468	C FXD CER 0.01μF 50V
	C529	52-05-2468	C FXD CER 0.01μF 50V
	C530	52-05-2468	C FXD CER 0.01μF 50V
	C531	54-00-0311	C FXD ELECT 10μF 50V
	C532	52-05-1498	C FXD CER 0.1μF 25V
	C533	54-00-0311	C FXD ELECT 10μF 50V
	C534	52-05-2468	C FXD CER 0.01μF 50V
	C535	52-06-3185	C FXD CER 47PF 500V
	C536	52-06-2225	C FXD CER 100PF 50V
	C537	54-00-0311	C FXD ELECT 10μF 50V
	C538	54-00-0311	C FXD ELECT 10μF 50V
	C539	54-00-0311	C FXD ELECT 10μF 50V
	C540	54-00-0311	C FXD ELECT 10μF 50V
	C541	52-06-3185	C FXD CER 47PF 500V
	C542	52-06-3185	C FXD CER 47PF 500V
	C543	54-00-0311	C FXD ELECT 10μF 50V
	C544	54-00-0311	C FXD ELECT 10μF 50V
	C545	54-00-0311	C FXD ELECT 10μF 50V
	C546	54-05-2468	C FXD CER 0.01μF 50V
	C547	52-06-3185	C FXD CER 47PF 500V
	C550	54-00-0311	C FXD ELECT 10μF 50V
	C551	54-00-1114	C FXD ELECT 47μF 25V
	C552	52-05-2468	C FXD CER 0.01μF 50V
	C553	52-05-2468	C FXD CER 0.01μF 50V
	C554	52-05-2468	C FXD CER 0.01μF 50V
	C555	52-05-1498	C FXD CER 0.1μF 25V
	C601	52-01-3385	C FXD CER 2200PF 500V
	C602	54-00-0311	C FXD ELECT 10μF 50V

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A9 C603	52-06-3185	C FXD CER 47PF 500V
C604	52-05-2468	C FXD CER 0.01μF 50V
C605	52-05-2468	C FXD CER 0.01μF 50V
C606	54-00-0311	C FXD ELECT 10μF 50V
C607	54-00-0114	C FXD ELECT 47μF 25V
C608	52-06-3145	C FXD CER 22PF 500V
C651	52-06-2468	C FXD CER 0.01μF 50V
C652	52-06-2225	C FXD CER 100PF 50V
C661	54-00-0114	C FXD CER 100PF 50V
C702	52-06-3051	C FXD CER 5PF 500V
C703	52-06-2265	C FXD CER 220PF 50V
C704	52-05-2468	C FXD CER 0.01μF 50V
C705	54-00-0311	C FXD ELECT 10μF 50V
C706	52-06-3102	C FXD CER 10PF 500V
C707	54-00-0114	C FXD ELECT 47μF 25V
C708	52-05-2468	C FXD CER 0.01μF 50V
C709	52-05-2468	C FXD CER 0.01μF 50V
C710	54-00-0311	C FXD ELECT 10μF 50V
C711	52-05-1498	C FXD CER 0.1μF 25V
C712	54-00-0311	C FXD ELECT 10μF 50V
C730	52-05-2468	C FXD CER 0.01μF 50V
C731	52-06-3145	C FXD CER 22PF 500V
C732	52-05-2468	C FXD CER 0.01μF 50V
C733	54-00-0114	C FXD ELECT 47μF 25V
C734	52-04-2468	C FXD CER 0.01μF 50V
C735	54-00-0311	C FXD ELECT 10μF 50V
C1103	54-61-1010	C FXD ELECT 100μF 100V
C1104	54-61-1080	C FXD ELECT 10μF 200V
C1105	54-61-1050	C FXD ELECT 100μF 160V
C1106	54-61-1050	C FXD ELECT 100μF 160V
C1107	54-61-1010	C FXD ELECT 100μF 100V
C1109	52-01-3345	C FXD CER 1000PF 500V
C1110	54-00-0314	C FXD ELECT 47μF 50V
C1111	54-01-0132	C FXD ELECT 2200μF 25V
C1112	54-01-0132	C FXD ELECT 2200μF 25V
C1113	54-01-0331	C FXD ELECT 1000μF 50V
C1114	52-01-3345	C FXD CER 1000PF 500V
C1115	52-01-3345	C FXD CER 1000PF 500V
C1116	54-00-0311	C FXD ELECT 10μF 50V
C1117	52-01-3345	C FXD CER 1000PF 500V
C1118	52-01-3345	C FXD CER 1000PF 500V
C1119	50-67-0040	C FXD PLSTC 0.022μF 100V
C1120	50-67-0040	C FXD PLSTC 0.022μF 100V
C1121	54-01-0132	C FXD ELECT 2200μF 25V
C1122	54-00-0311	C FXD ELECT 10μF 50V
C1123	52-05-2468	C FXD CER 0.01μF 50V
C1124	52-05-2468	C FXD CER 0.01μF 50V
C1125	52-05-2468	C FXD CER 0.01μF 50V
C1126	52-05-2468	C FXD CER 0.01μF 50V
C1127	52-05-2468	C FXD CER 0.01μF 50V
C1128	52-05-1498	C FXD CER 0.1μF 25V
C1129	52-05-1498	C FXD CER 0.1μF 25V
C1130	52-01-3345	C FXD CER 1000PF 500V
C1131	52-05-2468	C FXD CER 0.01μF 50V
C1151	50-45-0500	C FXD PLSTC 0.01μF 100V
C1152	50-45-0500	C FXD PLSTC 0.01μF 100V
C1153	54-00-0114	C FXD ELECT 47μF 25V
CR521-CR538	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR601-CR607	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR651-CR653	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR701-CR706	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR708-CR716	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR731-CR735	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR1101	32-90-0860	DIODE BRIDGE Si SIRBA60 SHINDENGEN
CR1102	32-90-0860	DIODE BRIDGE Si SIRBA60
CR1103	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR1104	32-90-0790	DIODE BRIDGE Si SIRBA20 SHINDENGEN
CR1105	32-90-0790	DIODE BRIDGE Si SIRBA20
CR1106	32-11-5880	DIODE Si 1S1588
CR1107	32-90-0520	DIODE Si V06G HITACHI
Q501	30-10-7810	TR Si PNP 2SA781 HITACHI
Q502	31-20-0580	TR FET 2SK58 SONY
Q503	30-31-7301	TR Si NPN 2SC1730-L NEC
Q504	30-31-7301	TR Si NPN 2SC1730-L NEC
Q505	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q506	30-31-7301	TR Si NPN 2SC1730-L NEC
Q507	30-31-7301	TR Si NPN 2SC1730-L NEC
Q508	30-31-7301	TR Si NPN 2SC1730-L NEC
Q509	30-31-7301	TR Si NPN 2SC1730-L NEC
Q510	30-10-7810	TR Si PNP 2SA781 HITACHI
Q511	30-10-7810	TR Si PNP 2SA781 HITACHI
Q512	30-10-7810	TR Si PNP 2SA781 HITACHI
Q513	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q514	30-30-9451	TR Si NPN 2SC945-Q NEC
Q515	30-30-9451	TR Si NPN 2SC945-Q NEC
Q516	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q517	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q518	30-30-9451	TR Si NPN 2SC945-Q NEC
Q601	31-20-1073	TR FET 2SK107-3 SONY
Q602	30-31-7301	TR Si NPN 2SC1730-L NEC
Q603	30-31-7301	TR Si NPN 2SC1730-L NEC
Q604	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q605	30-31-7301	TR Si NPN 2SC1730-L NEC
Q606	30-31-7301	TR Si NPN 2SC1730-L NEC
Q607	30-31-7301	TR Si NPN 2SC1730-L NEC
Q608	30-31-7301	TR Si NPN 2SC1730-L NEC

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A9 Q609	30-31-7301	TR Si NPN 2SC1730-L NEC
Q610	30-31-7301	TR Si NPN 2SC1730-L NEC
Q611	30-10-7810	TR Si PNP 2SA781 HITACHI
Q612	30-10-7810	TR Si PNP 2SA781 HITACHI
Q613	30-10-7810	TR Si PNP 2SA781 HITACHI
Q614	30-30-9451	TR Si NPN 2SC945-Q NEC
Q651	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q652	30-31-7301	TR Si NPN 2SC1730-L NEC
Q701	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q702	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q703	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q704	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q705	30-30-9451	TR Si NPN 2SC945-Q NEC
Q706	30-31-7301	TR Si NPN 2SC1730-L NEC
Q707	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q708	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q709	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q710	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q711	30-10-8441	TR Si PNP 2SA844-E HITACHI
Q712	30-10-8441	TR Si PNP 2SA844-E HITACHI
Q1102	30-30-9451	TR Si NPN 2SC945-O NEC
Q1103	30-32-3710	TR Si NPN 2SC2371-L NEC
Q1104	30-32-3710	TR Si NPN 2SC2371-L NEC
Q1107	30-30-9451	TR Si NPN 2SC945-Q NEC
Q1109	30-30-9451	TR Si NPN 2SC945-Q NEC
Q1110	30-30-9451	TR Si NPN 2SC945-Q NEC
R521	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R522	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R523	42-72-1560	R FXD M FILM 560Ω 1% 1/4W
R524	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R525	42-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R526	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R527	40-37-5101	R FXD C FILM 1MΩ 5% 1/2W
R528	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R529	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R530	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R531	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R532*	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R533	48-29-2200	R VAR M FILM 2KΩ
R534	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R535	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R536	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R537	40-27-3152	R FXD C FILM 15KΩ 5% 1/4W
R538	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R539	48-29-2100	R VAR M FILM 1KΩ
R540	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R541	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R542	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R543	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R544	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R545	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R546	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R547	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R548	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R549	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R550	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R551	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R552	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R553	40-27-2472	R FXD C FILM 4.7KΩ 5% 1/4W
R554	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R555	48-29-1500	R VAR M FILM 500Ω
R556	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R557	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R558	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R559	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R560	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R561	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R562	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R563	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R564	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R565	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R566	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R567	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R568	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R569	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R570	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R571	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R572	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R573	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R574	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R575	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R576	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R577	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R578	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R579	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R580	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R581	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R582	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R583	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R584	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R585	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R586	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R587	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R588	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R591	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R592	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R593	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R594	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R601	47-37-5101	R FXD C FILM 1MΩ 5% 1/2W
R602	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R603	40-27-1102	R FXD C FILM 100Ω 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A9 R604	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R605	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R606	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R607	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R608	40-27-2472	R FXD C FILM 4.7KΩ 5% 1/4W
R609	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R610	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R611	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R613	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R614	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R615	40-27-3152	R FXD C FILM 15KΩ 5% 1/4W
R616	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R617	40-27-3122	R FXD C FILM 12KΩ 5% 1/4W
R618	48-29-1100	R VAR M FILM 100Ω
R619	40-27-2182	R FXD C FILM 1.8KΩ 5% 1/4W
R620	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R621	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R622	40-27-3182	R FXD C FILM 18KΩ 5% 1/4W
R623	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R624	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R625	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R626	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R627	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R628	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R629	40-27-1272	R FXD C FILM 270Ω 5% 1/4W
R630	40-27-2472	R FXD C FILM 4.7KΩ 5% 1/4W
R632	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R633	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R634	48-29-2100	R VAR M FILM 1KΩ
R635	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R636	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R637	40-27-0822	R FXD C FILM 82Ω 5% 1/4W
R638	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R639	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R640	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R641	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R642	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R643	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R651	40-27-3122	R FXD C FILM 12KΩ 5% 1/4W
R653	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R654	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R655	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R656	40-27-3152	R FXD C FILM 15KΩ 5% 1/4W
R657	40-27-3122	R FXD C FILM 12KΩ 5% 1/4W
R658	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R659	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R660	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R661	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R662	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R663	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R664	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R665	40-27-2822	R FXD C FILM 8.2KΩ 5% 1/4W
R666	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R702	40-27-1682	R FXD C FILM 680Ω 5% 1/4W
R703	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R704	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R705	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R706	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R707	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R708	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R709	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R710	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R711	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R712	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R713	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R714	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R715	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R716	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R717	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R718	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R719	40-37-3471	R FXD C FILM 47KΩ 5% 1/2W
R720	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R721	40-27-3472	R FXD C FILM 47KΩ 5% 1/4W
R722	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R723	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R724	40-27-3152	R FXD C FILM 15KΩ 5% 1/4W
R725	48-29-2500	R VAR M FILM 5KΩ
R726	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R727	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R728	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R729	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R730	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R731	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R732	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R733	40-27-3152	R FXD C FILM 15KΩ 5% 1/4W
R734	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R735	48-29-2500	R VAR M FILM 5KΩ
R736	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R737	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R738	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R739	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R740	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R741	40-27-1822	R FXD C FILM 820Ω 5% 1/4W
R742	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R743	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R744	40-27-4222	R FXD C FILM 220KΩ 5% 1/4W
R745	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R746	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R747	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R748	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R749	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R750	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R751	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R790	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A9 R1101	41-91-3680	R FXD M OX 68KΩ 5% 1W
R1102	44-92-2100	R FXD M OX 1KΩ 5% 2W
R1103	40-27-3472	R FXD C FILM 47KΩ 5% 1/4W
R1104	40-27-3472	R FXD C FILM 47KΩ 5% 1/4W
R1105	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1107	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R1108	42-72-3680	R FXD M FILM 68KΩ 1% 1/4W
R1109	42-72-3100	R FXD M FILM 10KΩ 1% 1/4W
R1110	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R1111	40-27-1152	R FXD C FILM 150Ω 5% 1/4W
R1112	44-92-1150	R FXD M OX 150Ω 5% 2W
R1113	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1114	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1116	44-92-1150	R FXD M OX 150Ω 5% 2W
R1117	40-27-1152	R FXD C FILM 150Ω 5% 1/4W
R1118	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1119	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1121	47-72-2100	R FXD M FILM 1KΩ 1% 1/4W
R1122	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R1123	48-29-2100	R VAR M FILM 1KΩ
R1124	42-72-3120	R FXD M FILM 12KΩ 1% 1/4W
R1125	42-72-3120	R FXD M FILM 12KΩ 1% 1/4W
R1131	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R1132	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
R1133	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1134	40-37-8222	R FXD C FILM 2.2Ω 5% 1/2W
R1136	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R1137	42-72-2200	R FXD M FILM 2KΩ 1% 1/4W
R1138	42-72-2560	R FXD M FILM 5.6KΩ 1% 1/4W
R1141	40-37-5101	R FXD C FILM 1MΩ 5% 1/2W
R1142	40-37-5101	R FXD C FILM 1MΩ 5% 1/2W
R1151*	40-27-3822	R FXD C FILM 82KΩ 5% 1/4W
R1152	48-29-3500	R VAR M FILM 50KΩ
R1153	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R1154	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R1155	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R1156	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R1157	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R1158	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R1159	42-72-2680	R FXD M FILM 6.8KΩ 1% 1/4W
R1160	48-29-2500	R VAR M FILM 5KΩ
R1161	42-72-2180	R FXD M FILM 1.8KΩ 1% 1/4W
R1162	42-71-1200	R FXD M FILM 200Ω 0.5% 1/4W
R1163	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
S1101	81-01-0270	SW PUSH POWER SDG-5P
U501	35-70-0002	IC SN74S00N
U502	35-70-0001	IC SN74L500N
U503	35-70-1231	IC SN74LS123N
U504	35-70-0001	IC SN74L500N
U601	35-70-0002	IC SN74S00N
U701	35-70-1122	IC SN74S112N
U702	35-70-0001	IC SN74L500N
U703	35-70-0001	IC SN74L500N
U704	35-70-1122	IC SN74S112N
U705	35-70-0001	IC SN74L500N
U1101	34-40-0070	IC TA7179P DUAL TRACKING REGULATOR
U1102	35-60-0000	IC TA4011P C-MOS
A10 PCB-D A10	90-50-2100	PCB-D A10 SWEEP & HORIZ DRIVE
C750	52-03-3469	C FXD CER 0.01μF 500V
C751	52-05-1498	C FXD CER 0.1μF 25V
C801	52-05-2468	C FXD CER 0.01μF 50V
C802	57-10-1110	C VAR CER 2-22PF
C803	52-06-3215	C FXD CER 82PF 500V
C804	50-63-3500	C FXD PLASTIC 1μF 1% 200V
C805	50-73-3500	C FXD PLASTIC 0.01μF 1% 200V
C806	54-00-0311	C FXD ELECT 10μF 50V
C807	54-00-0311	C FXD ELECT 10μF 50V
C808	54-00-0311	C FXD ELECT 10μF 50V
C809	52-05-2468	C FXD CER 0.01μF 50V
C810	52-05-2468	C FXD CER 0.01μF 50V
C811	52-05-1498	C FXD CER 0.1μF 25V
C851	52-05-2468	C FXD CER 0.01μF 50V
C852	57-10-1110	C VAR CER 2-22PF
C853	52-06-3215	C FXD CER 82PF 500V
C854	50-63-3500	C FXD PLASTIC 1μF 1% 200V
C855	50-73-3500	C FXD PLASTIC 0.01μF 1% 200V
C856	52-03-3469	C FXD CER 0.01μF 500V
C857	52-05-2468	C FXD CER 0.01μF 50V
C858	54-00-0311	C FXD ELECT 10μF 50V
C859	52-05-2468	C FXD CER 0.01μF 50V
C861	52-05-1498	C FXD CER 0.1μF 25V
C862	52-05-2468	C FXD CER 0.01μF 50V
C901	54-00-0311	C FXD ELECT 10μF 50V
C902	52-05-2468	C FXD CER 0.01μF 50V
C903	52-05-2468	C FXD CER 0.01μF 50V
C921	52-06-2245	C FXD CER 150PF 50V
C922	52-06-2245	C FXD CER 150PF 50V
C931	52-05-2468	C FXD CER 0.01μF 50V
C932*	52-06-3205	C FXD CER 68PF 500V
C935	52-01-3305	C FXD CER 470PF 500V
C936	52-05-2468	C FXD CER 0.01μF 50V
C937	52-05-2468	C FXD CER 0.01μF 50V
C938	54-00-0311	C FXD ELECT 10μF 50V

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A10 C939	54-00-0114	C FXD ELECT 47μF 25V
C940	54-00-0311	C FXD ELECT 10μF 50V
C941	52-05-2468	C FXD CER 0.01μF 50V
C942	54-00-0311	C FXD ELECT 10μF 50V
C951	54-00-0311	C FXD ELECT 10μF 50V
CR751	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR752	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR753	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR801	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR811	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR812	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR813	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR814	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR815	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR851	32-11-5880	DIODE Si 1S1588 TOSHIBA
GR861	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR902	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR903	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR904	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR905	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR906	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR907	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR908	32-91-1800	DIODE Si RD5.6J-B VZ5.3-6.0V NEC
CR909	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR932	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR933	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR934	32-11-5880	DIODE Si 1S1588 TOSHIBA
Q751	31-90-0041	FET DUAL μPA63H-1 ΔVGS≤30mV NEC
Q752	30-30-9451	TR Si NPN 2SC945-Q NEC
Q753	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q754	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q755	30-30-9451	TR Si NPN 2SC945-Q NEC
Q801	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q802	31-20-1171	FET 2SK117-BL1 TOSHIBA
Q803	31-20-1171	FET 2SK117-BL1 TOSHIBA
Q804	31-90-0041	FET DUAL μPA63H-1 ΔVGS≤30mV NEC
Q805	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q806	31-31-7301	TR Si NPN 2SC1730-L NEC
Q807	30-30-9451	TR Si NPN 2SC945-Q NEC
Q808	30-30-9451	TR Si NPN 2SC945-Q NEC
Q809	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q810	30-30-9451	TR Si NPN 2SC945-Q NEC
Q811	30-30-9451	TR Si NPN 2SC945-Q NEC
Q851	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q852	31-20-1171	FET 2SK117-BL TOSHIBA
Q853	31-20-1171	FET 2SK117-BL TOSHIBA
Q854	31-90-0041	FET DUAL μPA63H-1 ΔVGS≤30mV NEC
Q855	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q856	30-31-7301	TR Si NPN 2SC1730-L NEC
Q857	30-30-9451	TR Si NPN 2SC945-Q NEC
Q858	30-30-9451	TR Si NPN 2SC945-Q NEC
Q859	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q860	30-30-9451	TR Si NPN 2SC945-Q NEC
Q861	30-30-9451	TR Si NPN 2SC945-Q NEC
Q901	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q902	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q903	30-30-9451	TR Si NPN 2SC945-Q NEC
Q904	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q905	30-31-7301	TR Si NPN 2SC1730-L NEC
Q906	30-31-7301	TR Si NPN 2SC1730-L NEC
Q907	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q908	30-31-7301	TR Si NPN 2SC1730-L NEC
Q909	30-31-7301	TR Si NPN 2SC1730-L NEC
Q910	30-31-7301	TR Si NPN 2SC1730-L NEC
Q911	30-31-7301	TR Si NPN 2SC1730-L NEC
Q912	30-31-7301	TR Si NPN 2SC1730-L NEC
Q913	30-31-7301	TR Si NPN 2SC1730-L NEC
QCR801-809	30-30-9451	TR Si NPN DIODE CONNE 2SC945-Q NEC
QCR851-859	30-30-9451	TR Si NPN DIODE CONNE 2SC945-Q NEC
R752	40-37-3101	R FXD C FILM 100KΩ 5% 1/2W
R753	40-37-3221	R FXD C FILM 220KΩ 5% 1/2W
R754	40-37-3221	R FXD C FILM 220KΩ 5% 1/2W
R755	40-27-3562	R FXD C FILM 56KΩ 5% 1/4W
R756	40-27-1682	R FXD C FILM 680Ω 5% 1/4W
R757	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R758	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R759	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R760	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R761	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R763	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R764	48-12-1201	R VAR M FILM 200Ω
R765	40-27-1332	R FXD C FILM 330Ω 5% 1/4W
R766	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W

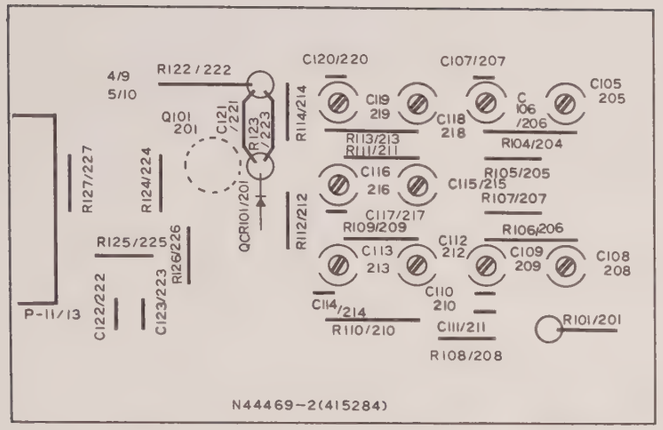
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A10 R767	42-72-3120	R FXD M FILM 12KΩ 1% 1/4W
R768	40-27-2102	R FXD C FILM 1KΩ5% 1/4W
R769	48-12-2201	R VAR M FILM 2KΩ
R770	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R771	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R772	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R801	40-27-2472	R FXD C FILM 4.7KΩ 5% 1/4W
R802	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R803	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R804	40-27-2471	R FXD C FILM 4.7KΩ 5% 1/2W
R805	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R806	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R807	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R808	42-24-0231	R FXD M GLAZE 5MΩ 1% 0.315W
R809	42-24-0221	R FXD M GLAZE 2MΩ 1% 0.315W
R810	42-73-5100	R FXD M FILM 1MΩ 0.5% 1/2W
R811	42-73-4500	R FXD M FILM 500KΩ 0.5% 1/2W
R812	42-71-4200	R FXD M FILM 200KΩ 0.5% 1/4W
R813	42-71-4100	R FXD M FILM 100KΩ 0.5% 1/4W
R814	42-71-3500	R FXD M FILM 50KΩ 0.5% 1/4W
R815	42-71-3200	R FXD M FILM 20KΩ 0.5% 1/4W
R816	42-71-3100	R FXD M FILM 10KΩ 0.5% 1/4W
R817	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R818	40-27-1272	R FXD C FILM 270Ω 5% 1/4W
R819	40-27-1272	R FXD C FILM 270Ω 5% 1/4W
R820	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
R821	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R822	48-29-1500	R VAR M FILM 500Ω
R823	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R824	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R825	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R826	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R827	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R828	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R829	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R830	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R831	44-08-0010	R FXD RESISTOR NETWORKS 10KΩ
R832	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R833	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R834	40-27-3392	R FXD C FILM 39KΩ 5% 1/4W
R851	40-27-2472	R FXD C FILM 4.7KΩ 5% 1/4W
R852	40-27-1222	R FXD C FILM 220Ω 5% 1/4W
R853	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R854	40-37-2471	R FXD C FILM 4.7KΩ 5% 1/2W
R855	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R856	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R857	40-27-1472	R FXD C FILM 470Ω 5% 1/4W
R858	42-24-0231	R FXD M GLAZE 5MΩ 1% 0.315W
R859	42-24-0221	R FXD M GLAZE 2MΩ 1% 0.315W
R860	42-73-5100	R FXD M FILM 1MΩ 0.5% 1/2W
R861	42-73-4500	R FXD M FILM 500KΩ 0.5% 1/2W
R862	42-71-4200	R FXD M FILM 200KΩ 0.5% 1/4W
R863	42-71-4100	R FXD M FILM 100KΩ 0.5% 1/4W
R864	42-71-3500	R FXD M FILM 50KΩ 0.5% 1/4W
R865	42-71-3200	R FXD M FILM 20KΩ 0.5% 1/4W
R866	42-71-3100	R FXD M FILM 10KΩ 0.5% 1/4W
R867	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R868	40-27-1272	R FXD C FILM 270Ω 5% 1/4W
R869	40-27-1272	R FXD C FILM 270Ω 5% 1/4W
R871	48-29-2500	R VAR M FILM 5KΩ
R872	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R873	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R874	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R875	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R876	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R877	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R878	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R879	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R880	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R881	40-27-2272	R FXD C FILM 2.7KΩ 5% 1/4W
R882	44-08-0010	R FXD RESISTOR NETWORKS 10KΩ
R884	40-27-3392	R FXD C FILM 39KΩ 5% 1/4W
R901	42-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R902	48-29-2100	R VAR M FILM 1KΩ
R903	42-72-2100	R FXD M FILM 1KΩ 1% 1/4W
R904	40-27-1102	R FXD M FILM 100Ω 5% 1/4W
R905	42-72-2270	R FXD M FILM 2.7KΩ 1% 1/4W
R906	48-29-2100	R VAR M FILM 1KΩ
R907	42-72-2100	R FXD M FILM 1KΩ 1% 1/4W
R908	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R909	48-29-1201	R VAR M FILM 200Ω
R910	42-72-1200	R FXD M FILM 470Ω 1% 1/4W
R911	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R912	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R913	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R914	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R915	40-27-3272	R FXD C FILM 27KΩ 5% 1/4W
R916	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R921	44-08-0010	R FXD RESISTOR NETWORKS 10KΩ
R923	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R924	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R931	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R932	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R933	42-72-1120	R FXD M FILM 120Ω 1% 1/4W
R934	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R935	42-72-2220	R FXD M FILM 2.2KΩ 1% 1/4W
R936	42-72-2120	R FXD M FILM 1.2KΩ 1% 1/4W
R937	48-29-2500	R VAR M FILM 5KΩ
R939	48-29-3500	R VAR M FILM 50KΩ
R940	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A10 R941	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R942	40-27-1152	R FXD C FILM 150Ω 5% 1/4W
R943	40-27-1152	R FXD C FILM 150Ω 5% 1/4W
R944	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R945	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R946	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R947	40-27-2472	R FXD C FILM 4.7KΩ 5% 1/4W
R948	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R949	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R951	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R952	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R953	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R954	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R955	40-27-4102	R FXD C FILM 100KΩ 5% 1/4W
R956	40-27-3102	R FXD C FILM 10KΩ 5% 1/4W
R957	40-27-3222	R FXD C FILM 22KΩ 5% 1/4W
R958	40-27-2682	R FXD C FILM 6.8KΩ 5% 1/4W
R959	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
U801	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U802	35-70-0081	IC QUAD2-1/P AND SN74LS08N
U803	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U804	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U805	30-90-0120	IC TRANSISTOR ARRAY μPA56C
U806	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U851	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U852	35-70-0081	IC QUAD2-1/P AND SN74LS08N
U853	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U854	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U855	30-90-0120	IC TRANSISTOR ARRAY μPA56C
U856	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
U901	35-70-0741	IC DUAL D,F,F SN74LS74N
U902	35-70-0001	IC QUAD2-1/P NAND SN74LS00N
A11 PCB-S A11	90-50-2110	PCB-S A11 DISPLAY MODE SW
SW901	81-05-0120	SW PUSH KSD-5-10-10 MLDC
A12 PCB-S A12	90-50-2120	PCB-S A12 HORIZ OUTPUT AMP
C962	52-05-2468	C FXD CER 0.01μF 50V
C963	52-05-2468	C FXD CER 0.01μF 50V
C964	50-05-2468	C FXD CER 0.01μF 50V
C965	52-05-1498	C FXD CER 0.1μF 25V
C966	52-03-3469	C FXD CER 0.01μF 500V
C967	52-05-2468	C FXD CER 0.01μF 50V
C968	52-05-2468	C FXD CER 0.01μF 50V
C969	52-05-2468	C FXD CER 0.01μF 50V
C970	52-05-2468	C FXD CER 0.01μF 50V
CR961	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR962	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR963	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR964	32-11-5880	DIODE Si 1S1588 TOSHIBA
CR965	32-91-1800	DIODE Si VZ5.3-6.0V RD5.6J-B NEC
CR966	32-91-1800	DIODE Si VZ5.3-6.0V RD5.6J-B NEC
Q961	30-31-7301	TR Si NPN 2SC1730-L NEC
Q962	30-31-7301	TR Si NPN 2SC1730-L NEC
Q963	30-32-3710	TR Si NPN 2SC2371-L NEC
Q964	30-32-3710	TR Si NPN 2SC2371-L NEC
Q965	30-32-3710	TR Si NPN 2SC2371-L NEC
Q966	30-32-3710	TR Si NPN 2SC2371-L NEC
R961	48-12-220D	R VAR M FILM 2KΩ
R962	40-27-2682	R FXD C FILM 6.8KΩ 5% 1/4W
R963	40-27-2682	R FXD C FILM 6.8KΩ 5% 1/4W
R965	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R966	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R967*	40-27-2152	R FXD C FILM 1.5KΩ 5% 1/4W
R968	40-27-3392	R FXD C FILM 39KΩ 5% 1/4W
R969	40-27-3392	R FXD C FILM 39KΩ 5% 1/4W
R970	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R971	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R973	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R974	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R975	42-74-4100	R FXD M FILM 100KΩ 5% 1/2W
R976	42-74-4100	R FXD M FILM 100KΩ 5% 1/2W
R977	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R978	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R979	40-37-3680	R FXD M OX 68KΩ 5% 1W
R980	40-37-3680	R FXD M OX 68KΩ 5% 1W
R981	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
R982	40-27-2122	R FXD C FILM 1.2KΩ 5% 1/4W
A13 PCB-S	90-50-2131	PCB-S A13 Z AXIS & CRT CIRCUIT
C1011	52-03-3469	C FXD CER 0.01μF 500V
C1012	52-03-3469	C FXD CER 0.01μF 500V
C1013	52-03-3469	C FXD CER 0.01μF 500V
C1014	52-03-3469	C FXD CER 0.01μF 500V
C1015	52-03-3469	C FXD CER 0.01μF 500V
C1016	54-00-0311	C FXD ELECT 10μF 50V
C1017	52-05-2468	C FXD CER 0.01μF 50V
C1018	52-05-2468	C FXD CER 0.01μF 50V
C1019	52-01-3345	C FXD CER 1000PF 500V
C1020	57-10-1190	C VAR CER 2-10PF
C1021	52-06-3051	C FXD CER 5PF 500V
C1022	52-05-2468	C FXD CER 0.01μF 50V
C1023	52-05-2468	C FXD CER 0.01μF 50V
C1024	52-03-3469	C FXD CER 0.01μF 500V
C1025	52-06-3010	C FXD CER 1PF 500V
C1026	57-10-1180	C VAR CER 1.5-4PF
C1027	52-05-2468	C FXD CER 0.01μF 50V
C1028	52-03-3469	C FXD CER 0.01μF 500V
C1029	52-05-1498	C FXD CER 0.1μF 25V

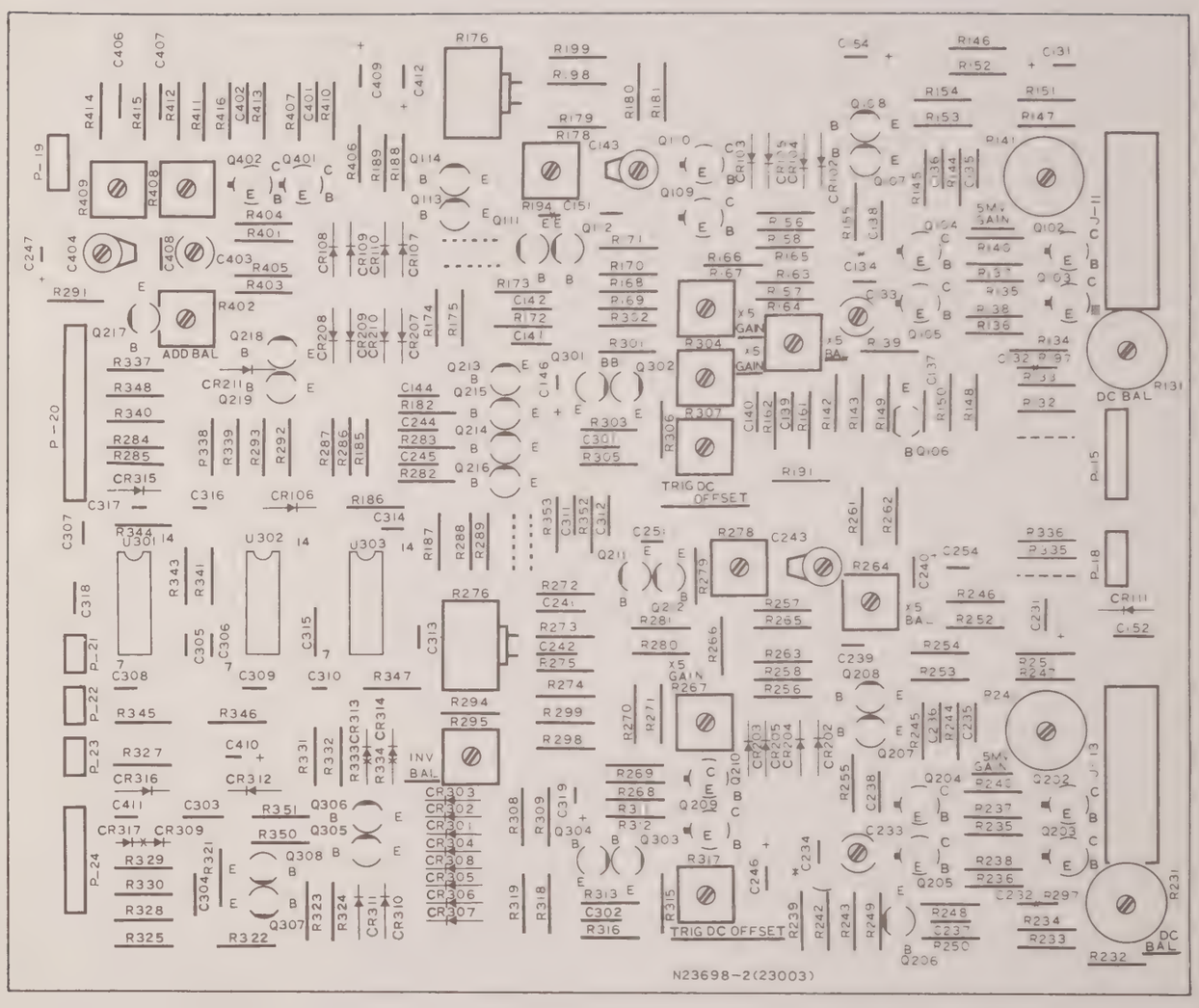
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A13 C1030	52-05-2468	C FXD CER 0.01μF 50V
C1031	52-01-5345	C FXD CER 1000PF 2KV
C1032	52-01-5345	C FXD CER 1000PF 2KV
C1033	52-01-5345	C FXD CER 1000PF 2KV
C1036	52-03-3469	C FXD CER 0.01μF 500V
C1037	52-01-5345	C FXD CER 1000PF 2KV
C1038	52-01-5345	C FXD CER 1000PF 2KV
C1039	52-01-5345	C FXD CER 1000PF 2KV
C1040	52-01-5345	C FXD CER 1000PF 2KV
C1041	52-01-5345	C FXD CER 1000PF 2KV
CR1011	32-11-5880	DIODE 1S1588 TOSHIBA
CR1012	32-11-5880	DIODE 1S1588 TOSHIBA
CR1013	32-11-5880	DIODE 1S1588 TOSHIBA
CR1014	32-11-5880	DIODE 1S1588 TOSHIBA
CR1015	32-30-0830	DIODE 1SS83 HITACHI
CR1016	32-11-5880	DIODE 1S1588 TOSHIBA
CR1017	32-11-5880	DIODE 1S1588 TOSHIBA
CR1018	32-11-5880	DIODE 1S1588 TOSHIBA
CR1019	32-30-0830	DIODE 1SS83 HITACHI
CR1020	32-30-0830	DIODE 1SS83 HITACHI
CR1021	32-30-0830	DIODE 1SS83 HITACHI
CR1022	32-30-0830	DIODE 1SS83 HITACHI
CR1023	32-30-0830	DIODE 1SS83 HITACHI
CR1024	32-30-0830	DIODE 1SS83 HITACHI
CR1025	39-00-0090	SURGE ABSORBER ERZ-C10DK471
CR1026	32-90-0290	DIODE ZENER 02Z15A TOSHIBA
CR1027	32-30-0830	DIODE 1SS83 HITACHI
CR1028	32-30-0830	DIODE 1SS83 HITACHI
CR1029	32-30-0830	DIODE 1SS83 HITACHI
CR1030	32-30-0830	DIODE 1SS83 HITACHI
CR1031	32-11-5880	DIODE 1S1588 TOSHIBA
CR1033	32-11-5880	DIODE 1S1588 TOSHIBA
Q1011	30-31-7301	TR 2SC1730-L NEC
Q1012	30-31-7301	TR 2SC1730-L NEC
Q1013	30-40-6681	TR 2SD668A HITACHI
Q1014	30-32-3710	TR 2SC2731-L NEC
Q1016	30-40-6681	TR 2SD668A HITACHI
Q1017	30-32-3710	TR 2SC2371-L NEC
Q1019	30-10-8381	TR 2SA838-B MATSUSHITA
R1011	48-26-4101	R VAR M FILM 100KΩ
R1012	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R1013	48-26-4101	R VAR M FILM 100KΩ
R1014	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R1015	48-26-4101	R VAR M FILM 100KΩ
R1016	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R1017	48-26-4101	R VAR M FILM 100KΩ
R1018	40-27-4472	R FXD C FILM 470KΩ 5% 1/4W
R1020	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R1021	40-27-2392	R FXD C FILM 3.9KΩ 5% 1/4W
R1022	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R1023	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R1024	40-27-3392	R FXD C FILM 39KΩ 5% 1/4W
R1025	40-27-1562	R FXD C FILM 560Ω 5% 1/4W
R1026	40-27-1392	R FXD C FILM 390Ω 5% 1/4W
R1027	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R1028	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R1029	44-91-3680	R FXD M OX 68KΩ 5% 1W
R1030	44-91-3680	R FXD M OX 68KΩ 5% 1W
R1031	40-27-1122	R FXD C FILM 120Ω 5% 1/4W
R1032	40-27-0682	R FXD C FILM 68Ω 5% 1/4W
R1033	40-27-3562	R FXD C FILM 56KΩ 5% 1/4W
R1034	40-27-3822	R FXD C FILM 82KΩ 5% 1/4W
R1035	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R1036	40-37-4121	R FXD C FILM 120KΩ 5% 1/2W
R1037	40-27-1122	R FXD C FILM 120Ω 5% 1/4W
R1038	40-37-5101	R FXD C FILM 1MΩ 5% 1/2W
R1039	40-37-6101	R FXD C FILM 10MΩ 5% 1/2W
R1040	40-37-6101	R FXD C FILM 10MΩ 5% 1/2W
R1041	48-26-5100	R VAR M FILM 1MΩ CR19R1MΩ
R1042	42-44-0260	R FXD M GLAZE 2.5MΩ 1% 1.6W
R1043	40-27-2562	R FXD C FILM 5.6KΩ 5% 1/4W
R1044	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R1045	40-27-2332	R FXD C FILM 3.3KΩ 5% 1/4W
R1046	40-37-5221	R FXD C FILM 2.2MΩ 5% 1/2W
R1047	40-37-5101	R FXD C FILM 1MΩ 5% 1/2W
R1048	40-37-6101	R FXD C FILM 10MΩ 5% 1/2W
R1049	40-37-6101	R FXD C FILM 10MΩ 5% 1/2W
R1050	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R1051	42-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R1052	42-44-0260	R FXD M GLAZE 2.5MΩ 1% 1.6W
R1053	42-44-0260	R FXD M GLAZE 2.5MΩ 1% 1.6W
R1054	42-72-2560	R FXD M FILM 5.6KΩ 1% 1/4W
R1055	42-72-2680	R FXD M FILM 6.8KΩ 1% 1/4W
R1056	48-29-2500	R VAR M FILM 5KΩ
R1057	42-72-3190	R FXD M FILM 19KΩ 1% 1/4W
R1058	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R1059	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R1061	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R1062	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
R1063	40-27-0102	R FXD C FILM 10Ω 5% 1/4W
V1002	23-70-0000	LAMP NEON NE-2
V1003	23-70-0000	LAMP NEON NE-2

REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
A14 PCB-S A14	90-50-2141	PCB-S A14 HV REGULATOR
C1071	50-67-0060	C FXD PLSTC 0.1μF 100V
C1072	54-00-0311	C FXD ELECT 10μF 50V
C1073	54-00-0311	C FXD ELECT 10μF 50V
C1074	54-00-0314	C FXD ELECT 47 μF 50V
C1075	52-98-1010	C FXD CER 4700PF 3KV
C1076	52-98-1010	C FXD CER 4700PF 3KV
C1077	52-98-1010	C FXD CER 4700PF 3KV
C1078	50-67-0060	C FXD PLSTC 0.1μF 100V
C1079	52-08-5145	C FXD CER 22PF 2KV
CR1071	32-90-1820	DIODE Si ERB26-20FUJITSU
CR1072	32-90-1820	DIODE Si ERB26-20 FUJITSU
Q1071	30-30-9001	TR Si NPN 2SC900 NEC
Q1072	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q1073	30-10-8381	TR Si PNP 2SA838-B MATSUSHITA
Q1074	30-40-8802	TR Si NPN 2SD880-Y TOSHIBA
R1071	40-27-1102	R FXD C FILM 100Ω 5% 1/4W
R1072	40-27-1682	R FXD C FILM 680Ω 5% 1/4W
R1073	40-27-4222	R FXD C FILM 220KΩ 5% 1/4W
R1074	40-27-2222	R FXD C FILM 2.2KΩ 5% 1/4W
R1075	40-27-0332	R FXD C FILM 33Ω 5% 1/4W
R1076	40-27-2102	R FXD C FILM 1KΩ 5% 1/4W
R1077	40-37-8222	R FXS C FILM 2.2Ω 5% 1/2W
R1078	40-27-8472	R FXD C FILM 4.7Ω 5% 1/4W
R1079	40-37-3681	R FXD C FILM 68KΩ 5% 1/2W
R1080	40-37-4471	R FXD C FILM 470KΩ 5% 1/2W
R1081	40-27-8472	R FXD C FILM 4.7Ω 5% 1/4W
T1001	63-92-0060	T DC-DC CONV, TRANS S751094
A15 PCB-S A15	90-50-2150	PCB-S A15 HV MULTI.
CR1081-CR1091	32-90-1820	DIODE Si ERB26-20 FUJITSU
C1081-C1091	52-01-5345	C FXD CER 1000PF 2KV
R1091	40-37-5101	R FXD C FILM 1MΩ 5% 1/2W
A16 PCB-S A16	90-50-2161	PCB-S A16 ILLUM
DS101-DS103	23-35-0040	LAMP FILAMENT 8V 0.1A BQ041-22803A

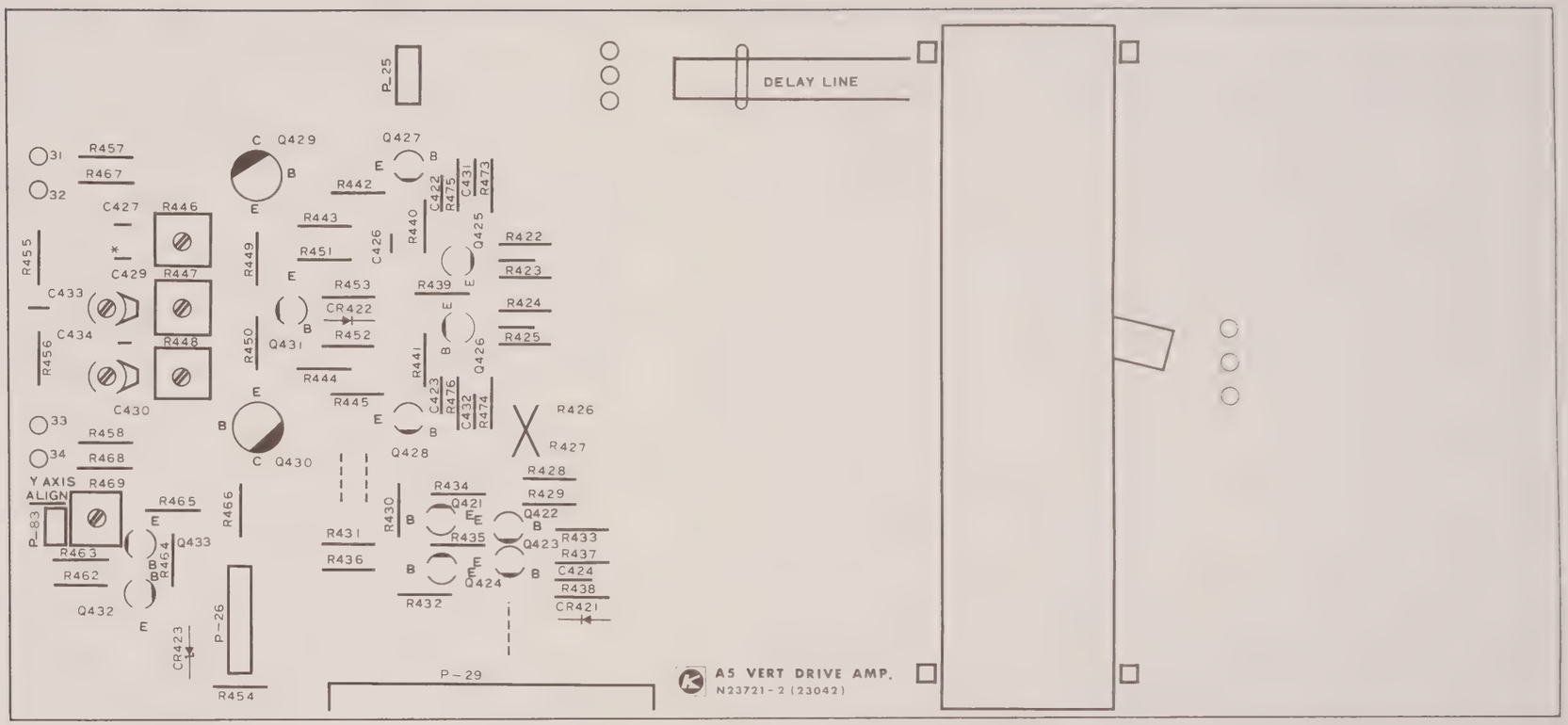
REFERENCE DESIGNATOR	KIKUSUI PARTS NO.	DESCRIPTION
MISCELLANEOUS		
C501	50-67-0060	C FXD PLSTC 0.1μF 100V
C502	52-06-3185	C FXD CER 47PF 500V
C503	52-06-3145	C FXD CER 22PF 500V
C504	52-06-2245	C FXD CER 150PF 50V
C1101	52-77-1000	C FXD CER 1000PF 250VAC
C1102	52-77-1000	C FXD CER 1000PF 250VAC
CR101	37-00-0040	LED LMP RED TLR104
CR201	37-00-0040	LED LMP RED TLR104
CR364	37-00-0050	LED LMP CLEAR TLR106
CR365	37-00-0050	LED LMP CLEAR TLR106
CR721	37-00-0140	LED LMP GREEN TLG103
CR722	37-00-0050	LED LMP CLEAR TLR106
CR723	37-00-0050	LED LMP CLEAR TLR106
CR862	37-00-0040	LED LMP RED TLR104
CR1001	37-00-0050	LED LMP GREEN TLG105
F1101	99-02-0120	FUSE 250V 1A FGT41
F1101	99-02-0115	FUSE 250V 0.5A FGT41
L1001	66-21-0040	COIL ROTATION S-7809293
Q1101	30-40-3811	TR Si NPN 2SD381-L NEC
Q1105	30-20-5361	TR Si PNP 2SB536 NEC
Q1106	30-40-3811	TR Si NPN 2SD381-L
Q1108	30-40-3811	TR Si NPN 2SD381-L
R101	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R201	40-27-0222	R FXD C FILM 22Ω 5% 1/4W
R380	40-27-0562	R FXD C FILM 56Ω 5% 1/4W
R381	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R382	40-27-0472	R FXD C FILM 47Ω 5% 1/4W
R501	42-73-4900	R FXD M FILM 900KΩ 1% 1/2W
R502	42-71-4111	R FXD M FILM 111KΩ 1% 1/2W
R503	40-27-3472	R FXD M FILM 47KΩ 5% 1/4W
R612 (WITH S601)	45-01-0410	R VAR C COMP 100K RV16YN-15SB100K ME
R773	49-26-3100	R VAR M 10T 22S10 POTENTIOMETER 10KΩ
R835 (WITH SW802)	45-01-0380	R VAR C COMP 5KΩ V16L4 (7x5) (PH)S-10SB5KΩ
R991	45-02-0200	R VAR C COMP 10KΩ+10KΩ V16L4GN20(6)R30(3.2)RB10K+B10KΩ
S301	81-03-0150	SW PUSH KSD3-6-10LLDC
S501	82-71-0060	SW LEVER J19-124
S502	82-71-0060	SW LEVER J19-124
S602	81-02-0080	SW PUSH KDS2-4-10 LLDC
SW801	80-99-0030	SW ROTARY TIME/DIV
SW802	-	SEE R835 (A PART OF R835)
S601	-	SEE R612 (A PART OF R612)
T1101	60-48-0010	P.T 5630
V1001	21-46-0602	CRT 150BFB31 HITACHI
MULTI DIAL	W1-000-012	MULTI DIAL CA-10
AC CORD CONNECTOR	83-20-3010	AC CORD CONNECTOR CM-3
AC CORD	85-10-0120	AC CORD SET
PROBE	89-03-0220	MODEL 960 BNC (1.5m) PROBE
KNOB	N1-000-171	KNOB R12SB-3.2 12ϕ SINGLE BLACK
KNOB	N1-000-011	KNOB R12SB 12ϕ SINGLE FOR POSITION
KNOB	N1-000-181	KNOB R 10SB-3.2
KNOB	N1-000-051	KNOB D22WB (BLACK)
KNOB	N2-000-011	KNOB R12WR (RED)
KNOB	N1-000-191	KNOB R42WB
PUSH BUTTON	P2-000-201	PUSH BUTTON BLACK
PUSH BUTTON	P2-000-211	PUSH BUTTON BLUE
PUSH BUTTON	P2-000-281	PUSH BUTTON GREEN
BEZEL	P2-050-111	BEZEL (SQUARE 5 INCHES)
FILTER	S4-563-0111	SCREEN FILTER (BLUE)
CARRYING HANDLE	E6-050-052	CARRYING HANDLE
HOLDER CORD	P2-000-271	HOLDER LINE CORD



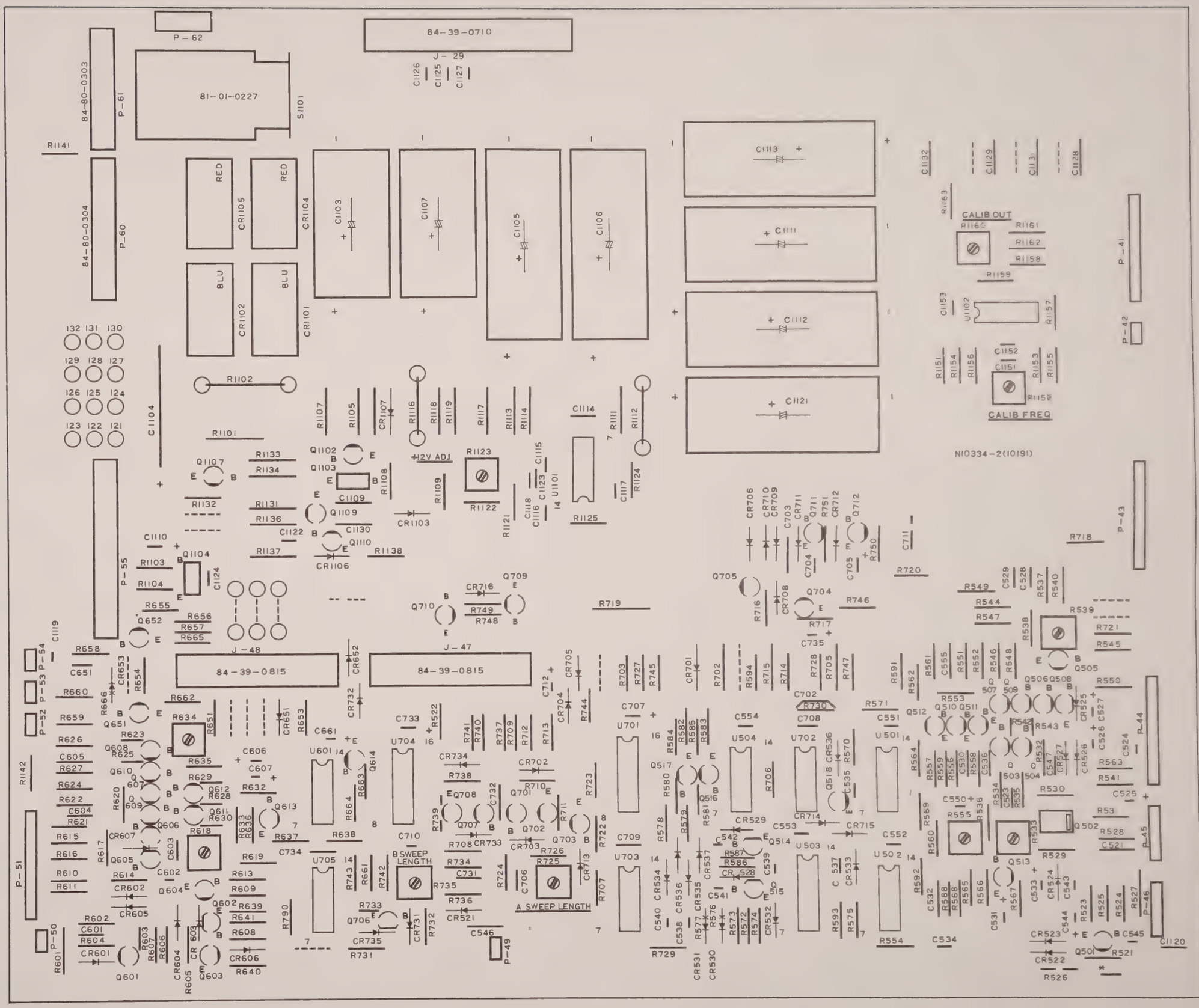
A1 VERT ATT Parts Location



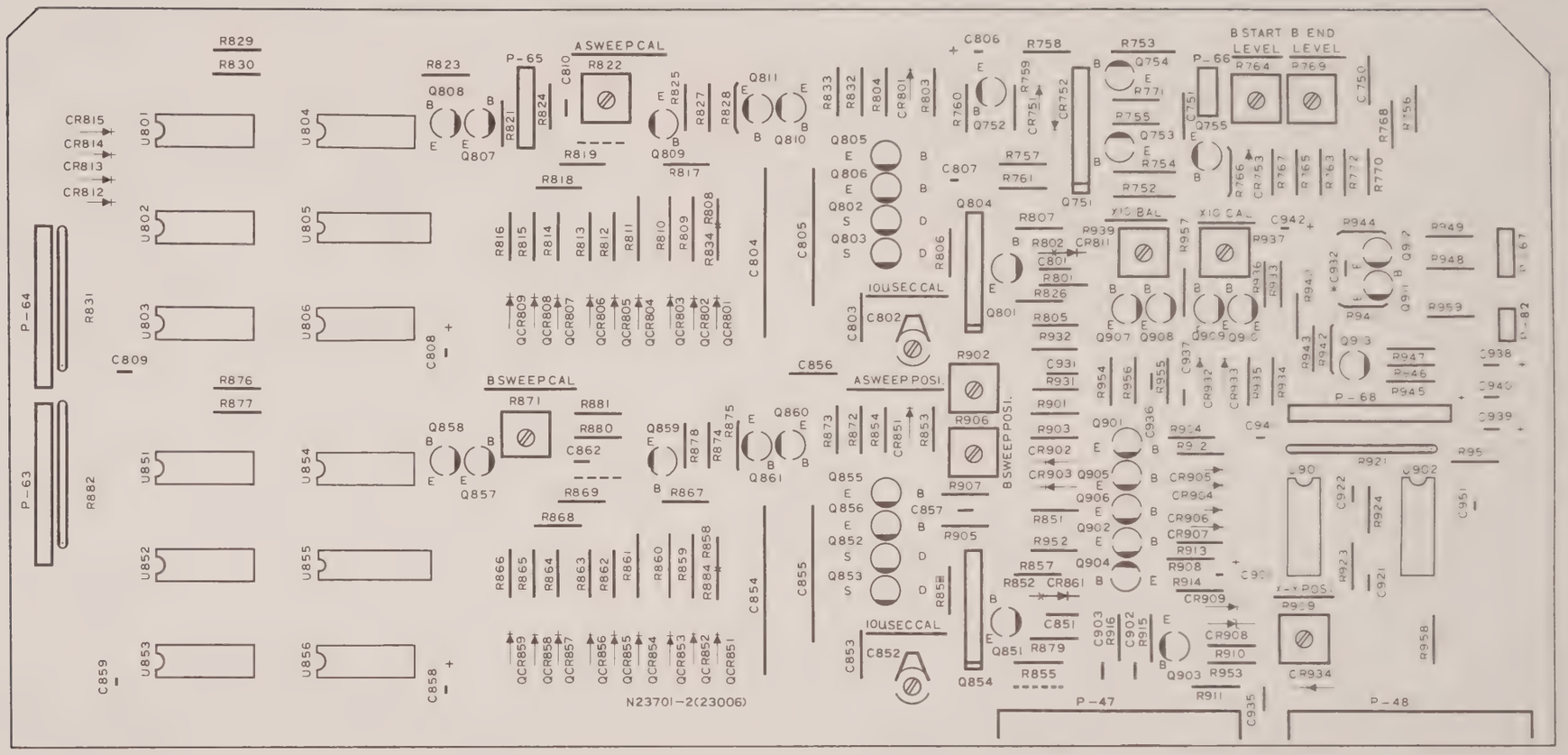
A4 VERT PREAMP Parts Location



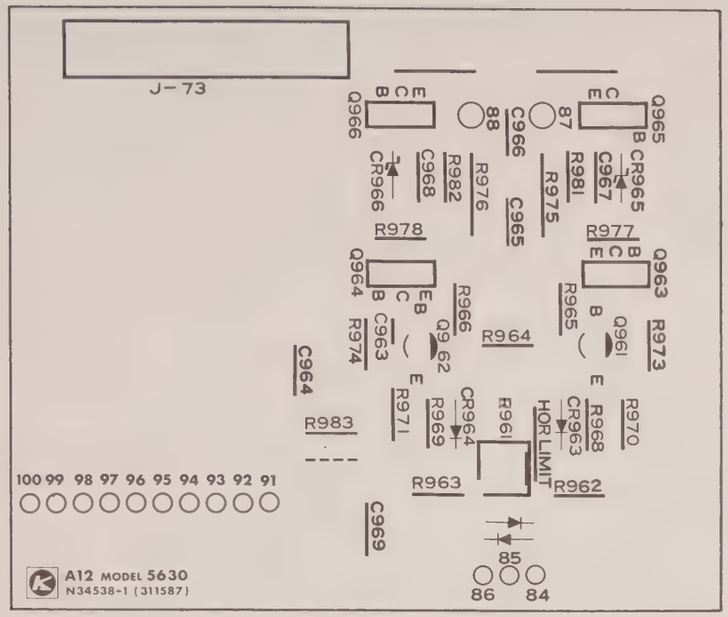
A5 VERT DRIVE AMP Parts Location



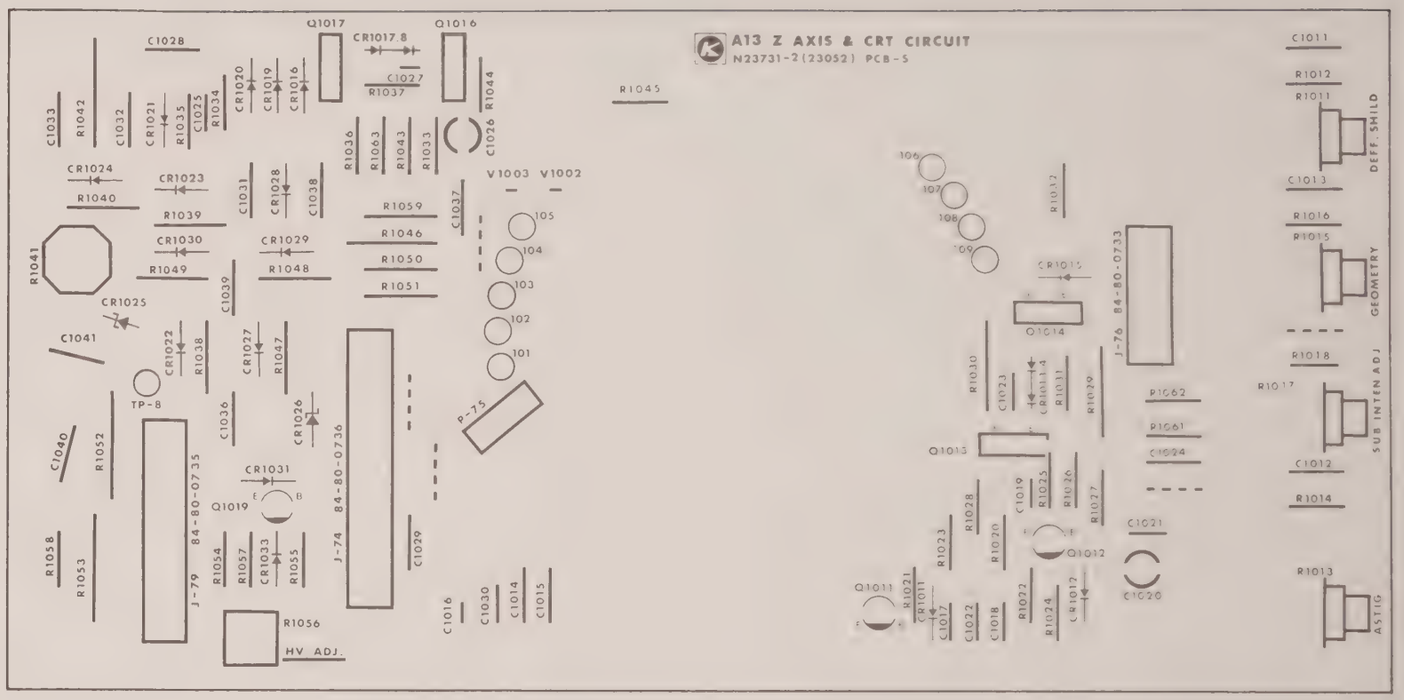
A9 TRIG & POWER SUPPLY Parts Location



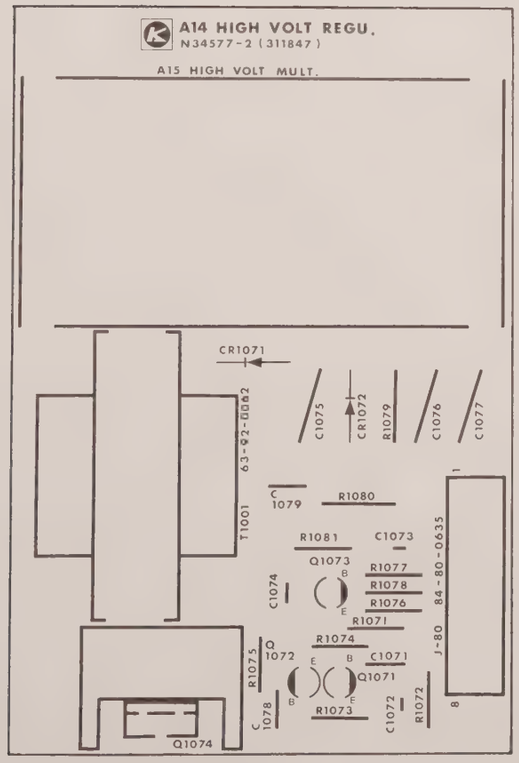
A10 SWEEP & HORIZ DRIVE Parts Location



A12 HORIZ OUTPUT AMP Parts Location



A13 Z AXIS & CRT CIRCUIT Parts Location



A14 HV REGULATOR Parts Location

WARRANTY

All instruments manufactured by KIKUSUI ELECTRONICS CORP. are warranted against defects in materials and workmanship for a period of two years from the date of original shipment from the factory. However, this warranty excludes batteries, lead wires and probes, and CRT's are warranted only for a period of one year from the date of original shipment from the factory.

In the event of any defects in materials or workmanship, KIKUSUI ELECTRONICS CORP. will, at its sole option, repair or replace the defective instrument covered by this warranty without charge. To obtain warranty service, the defective instrument must be returned within thirty (30) days of the expiration of the applicable warranty period to KIKUSUI INTERNATIONAL CORP. properly packaged and with transportation and insurance prepaid. We will reship at our expense only to destinations in the United States.

Any defect in materials or workmanship determined by KIKUSUI INTERNATIONAL CORP. to be attributable to customer alteration, modification, negligence or misuse is not covered by this warranty.

EXCEPT AS SET FORTH ABOVE, KIKUSUI ELECTRONICS CORP. AND KIKUSUI INTERNATIONAL CORP. MAKE NO WARRANTIES EITHER EXPRESS OR IMPLIED, WITH RESPECT TO SUCH INSTRUMENTS, AND SHALL NOT BE LIABLE OR RESPONSIBLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Kikusui International Corp.

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